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FORTIETH

ANNUAL REPORT OF THE SECRETARY

OF THE

MASSACHUSETTS

State Board of Agriculture,

TOGETHER WITH THE

TENTH ANNUAL REPORT OF THE STATE AGRICULTURAL EXPERIMENT STATION.

1892.

BOSTON:
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1893.

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STATE BOARD OF AGRICULTURE, 1893.

Members ex Officio.

HIS EXCELLENCY WM. E. RUSSELL.
HIS HONOR ROGER WOLCOTT.
HON. WM. M. OLIN, *Secretary of the Commonwealth.*
H. H. GOODELL, M.A., LL.D., *President Massachusetts Agricultural College.*

Members appointed by the Governor and Council.

	Term Expires.
ELBRIDGE CUSHMAN of Lakeville (P. O. Middleborough),	1894
D. A. HORTON of Northampton,	1895
JAMES S. GRINNELL of Greenfield,	1896

Members chosen by the Incorporated Societies.

Amesbury and Salisbury (Agr'l and Hort'l),	F. W. SARGENT of Amesbury,	1894
Attleborough (Agr'l Assoc'n),	ISAAC ALGER of Attleborough,	1894
Barnstable County,	JOHN BURSLEY of West Barnstable,	1895
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Bristol County,	N. W. SHAW of North Raynham,	1896
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Eastern Hampden,	WM. HOLBROOK, M.D., of Palmer,	1894
Essex,	F. H. APPLETON of Peabody (P. O. Lynnfield),	1896
Franklin County,	J. C. NEWHALL of Conway,	1895
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Hampshire,	L. W. WEST of Hadley,	1895
Hampshire, Franklin and Hampden,	E. C. CLAPP of Northampton,	1894
Highland,	H. A. BARTON, JR., of Dalton,	1896
Hillside,	WM. BANCROFT of Chesterfield,	1896
Hingham (Agr'l and Hort'l),	EDMUND HERSEY of Hingham,	1894
Hoosac Valley,	A. J. BUCKLIN of Adams,	1894
Housatonic,	J. H. ROWLEY of Egremont Plain,	1894
Marshfield (Agr'l and Hort'l),	L. S. RICHARDS of Marshfield (P. O. Marshfield Hills),	1894
Martha's Vineyard,	N. S. SHALER of Cambridge,	1895
Massachusetts,	HENRY S. RUSSELL of Milton,	1894
Massachusetts Horticultural,	E. W. WOOD of West Newton,	1894
Middlesex,	W. W. RAWSON of Arlington,	1894
Middlesex North,	A. C. VARNUM of Lowell,	1895
Middlesex South,	ISAAC DAMON of Wayland (P.O. Cochituate),	1896
Nantucket,	WM. W. McINTOSH of Nantucket,	1894
Oxford,	JOHN E. KIMBALL of Oxford,	1895
Plymouth County,	AUGUSTUS PRATT of North Middleborough,	1896
Spencer (Far's and Mech's Assoc'n),	EDWARD WARREN of Leicester (P. O. Spencer),	1895
Union (Agr'l and Hort'l),	G. C. ROWLEY of Blandford,	1895
Weymouth (Agr'l and Ind'l),	QUINCY L. REED of South Weymouth,	1894
Worcester,	C. L. HARTSHORN of Worcester,	1896
Worcester East,	W. A. KILBOURN of South Lancaster,	1894
Worcester North,	GEORGE CRUICKSHANKS of Fitchburg,	1896
Worcester North-west (Agr'l and Mech'l),	WM. H. BOWKER of Boston,	1895
Worcester South,	G. L. CLEMENCE of Southbridge (P. O. Globe Village),	1895
Worcester County West,	E. A. HARWOOD of North Brookfield,	1896

Secretary of the Board, WM. R. SESSIONS of Hampden.
Chemist to the Board, C. A. GOESSMANN, Ph.D., LL.D., of Amherst.
Entomologist to the Board, C. H. FERNALD, Ph.D., of Amherst.
Office of the Secretary, Commonwealth Building, Boston.

THE FORTIETH ANNUAL REPORT

OF THE

SECRETARY

OF THE

BOARD OF AGRICULTURE.

To the Senate and House of Representatives of the Commonwealth of Massachusetts.

The year 1892 was a prosperous one for our farmers, and the report of the secretary is a report of progress.

MASSACHUSETTS WEATHER IN 1892.

January was warmer than the average, and the precipitation was greater than usual in the central counties. The snowfall was deficient. Snow, ice and bare ground alternated at the end of the month. The prevailing wind was from the north-west. A thunder-storm occurred at Williamstown on the 2d.

February was warm and dry. The precipitation was least along the coast. From eight to twenty-six inches of snow fell in the western part of the State and from one to eight inches in the eastern. Only a trace of snow remained on the ground at the end of the month. The prevailing direction of the wind was from the north-west.

March was cool and dry. On the extreme southern Rhode Island and Massachusetts coast the precipitation was above the average, but in other sections it was below. The prevailing wind was from the north-west. Thunder-storms were observed at Hyannis and Mansfield on the 10th, and at New Bedford and Randolph on the 11th.

April was warm and dry. Very little snow fell. The prevailing wind was from the north-west. A well-marked thunder-storm occurred on the 2d.

The weather for May was characterized by an excess of rainfall and number of rainy days and an unusually high mean wind velocity. The mean temperature was slightly below the average and the monthly range was strong. There was an excess of westerly and northerly winds and less southerly and easterly winds than usual. The precipitation for the month was greatest in the central and western districts and least on the coast. A remarkably late snow-storm occurred on the 20th. This was felt only on the western highlands, but was severe there as well as in Vermont and New Hampshire.

The weather for June was characterized by a very high mean temperature, with great variability, especially during the middle of the month; heavy local storms accompanied by thunder and lightning, high winds and hail, prevailing southerly winds and an excess of rainy days. The mean temperature was from 1° to over 3° above the average throughout the State. The lowest occurred on the morning of the 11th, when considerable damage was done in the eastern districts by frost. From the 11th to the 14th there were very strong ranges of temperature with steadily increasing heat each day, until on the latter date it rose to 90° and over, at all stations except at some of those very near the coast; thus the range for the month was unusually large. The precipitation was about one inch below the normal on the southern coast, but considerably above the average in the northern and western districts. The heaviest hail-storm occurred on the 14th, and did the most damage in the upper Connecticut valley at Greenfield; thousands of dollars' worth of damage was done to windows, and in other towns farther east much glass was broken.

The month of July was characterized by excessive heat, great range in temperature, large amount of sunshine, low humidity, deficiency of clouds and a lack of rainfall. Unusually low temperatures occurred on the 4th, 6th and 17th, light frosts being reported in some low lands. High temperatures were experienced from the 10th to 15th and from the 22d to the 29th; the last period was the hottest spell of weather felt in Massachusetts for several years. Very little rain fell in any section of the State from the 4th to the 28th, and this, coupled with the intense heat, caused a sharp though not unusually severe drought. The greatest damage was probably done to potatoes, although grain, garden truck, pastures and newly mowed fields suffered to considerable extent. The drought ended with heavy thunderstorms on the 28th and 29th in the central and western sections, and a heavy north-east rain on the 31st.

The weather for the month of August was characterized by a nearly average temperature, air pressure and sunshine, while the precipitation was above the average in the central counties and at or below the average in the eastern. The maximum temperature occurred generally on the 10th, ranging from 88° to 98°. The minimum was felt on different dates at different stations, and was about 50°; hence the range for the month was not nearly so large as was experienced in July. The dry weather that prevailed during the greater part of July was continued through most of August in Plymouth and Bristol counties, causing damage to nearly all crops there; fruit dropped badly, field and garden crops dried up for want of water, and fields and pastures turned brown. But in the central and western parts of the State seasonable rains fell, and all vegetation was given rapid growth. The local storms were heavy and frequent, and much damage was done by lightning.

The month of September had very nearly a normal temperature, a deficiency of rainfall except in the vicinity of New Bedford, and an air pressure and amount of sunshine above the average. Few storms influenced the weather. The highest temperature occurred on the 19th, ranging slightly over 80°. The lowest was on the 21st or 30th, and was very near the freezing point of water. Thus, while the monthly range was not large, the daily ranges were very strong and generally rapid. While at Taunton light frosts were reported on twelve days and killing frosts on three, at Fitchburg no frost had occurred at the end of the month. Over the greater part of the State the damage by frosts was very slight. In this respect the season was unusually favorable, both during the late spring and the early fall. At New Bedford the rainfall for the month was over three inches; two inches and over fell in the south-eastern part of the State and in the extreme west, while from one to two inches only was registered in all the central districts. Thunder-storms were few, but that of the 26th was very severe and did considerable damage.

The weather for the month of October was unusually mild and pleasant. The highest temperature occurred on the 8th or 14th, and the lowest on the 25th, 28th or 29th. The maximum was not unusually high, and the minimum was not so low as is generally recorded. At Newburyport no general killing frost had occurred, and at Leominster the first frost to injure vegetation on high lands was on the 28th. The observer at Chestnut Hill reported that wild violets were picked on the 25th. The observer at Taunton reported that the weather continued unusually mild, and in many places dandelions and roses were in blossom. The number of rainy and cloudy days was small, and the amount of sunshine was in excess. The precipitation was much below the usual amount in all parts of the State. At Springfield it was the least ever recorded in October in forty-five years of observation. At Clinton the fall for the month was only 0.39 inch. This lack of precipitation, coming after several months of small rainfall, caused a general drought. A thunder-storm on the 16th was quite severe in the vicinity of Mansfield.

November was wet, with a nearly normal temperature. The temperature ranges were neither large nor rapid; the maximum was slightly over 60°, and occurred on the 17th. The minimum was generally on the 24th, and ranged from 10° to 20° below the freezing point of water. The precipitation was above the normal, being quite heavy on the southern coast. During the storm of the 9th–10th the rainfall at Springfield was 2.58 inches; at Westborough, 2.55 inches; and at Wood's Hell, 2.54 inches. On the 15th–16th 2.70 inches fell at Adams and 2.73 at Monroe. On the 29th–30th the fall at Hyannis was 2.75 inches. Severe wind storms occurred in the western part of the State on the 18th, doing much damage to trees and buildings. On the 30th the north-east storm did much damage along the coast. The ground was free from snow during the greater part of the month, but the temperature was so equable that little or no damage was done to grass and grain crops. The growth of grass in the fall was quite heavy, affording a protection to the grass roots during the winter.

December was cold and very dry. About two inches of rain fell on the extreme southern coast, but over the rest of the State the fall was but little over one inch. At Boston the daily mean temperature was above the normal from the 7th to the 17th, and below from the 20th to 30th. During these last ten days occurred one of the most continuously cold spells for several years. At New Bedford the monthly mean temperature was nearly 4° below the normal for eighty-one years. The temperature was below the normal throughout the entire United States, except along the southern coast. The snowfall was deficient, and not more than a trace lay on the ground on the 15th or 31st.

Crops of the Year.

The general opinion of correspondents the first of June was that the season was cold and backward, but that it promised to be favorable for the farmer. The winter of 1890–91 was quite favorable for stock. April was dry and cool. May was wet, and planting was delayed. Most correspondents referred to the presence of the tent caterpillar. Nearly all correspondents were agreed that it was very difficult to get first-class farm help. Judging by the returns, it was thought that twenty-two dollars per month and board was the average of wages paid for such help.

The first of July corn was reported as backward, but of good color and growing well, with acreage increased. Haying had been delayed by wet, cloudy weather since June 22, and considerable cut grass was damaged. It was thought that the crop as a whole would be an unusually large one. A correspondent in Franklin County reported old mowings as badly winter-killed. Considerable complaint was made in Worcester County of damage to grass by spittle insects. The acreage of early potatoes was reported as about the same as the previous year, with condition generally good. There appeared to be little change in the quantity of dairy products, as compared with previous years. Pastures were reported as being in good condition. There was very general complaint of raspberry canes having been winter-killed. Generally, the strawberry crop was a good one. Other small fruits, excepting cherries and pears, promised well.

August 1, about an average hay crop, of excellent quality as a rule, was reported as secured. The weather for securing the crop was very favorable. Yield of early potatoes, where dug, reported as light. Dry weather had greatly injured late potatoes, especially on high lands. Quite general complaint was made of apples dropping from the trees. The bloom was good, and many apples set. Up to the middle of July pastures were in excellent condition, but drought greatly injured them, and many correspondents reported them as being dried up. Rye, generally, was a very good crop, and harvested in good condition. Small fruits were shortened in yield by drought. Tobacco doing well. Oats rusting some.

September 1, corn generally promised to be a good crop. Rowen promised to be very near if not quite an average crop, although very light in south-eastern sections. The oat crop averaged well with last year. Potatoes not promising well, and some complaint of blight and rot. Apples reported as still dropping. Pastures very much improved by rains. Onion crop uneven in condition and yield. Celery looking well, but late. Tobacco generally harvested, and a very good crop. Cranberries promised less than an average crop. Some complaint was made of the presence of the horn fly on cattle.

October 1, a majority of the returns of correspondents indicated Indian corn to be a full average, and that the crop was secured in excellent condition. Some complaint from Barnstable County of injury to the ears by worms boring into them. Crop below the average in south-eastern sections. Rowen in central and western sections a full average crop, but light in eastern and south-eastern sections. An average amount of fall seeding done, and looking well. Correspondents about evenly divided as to whether the onion crop was an average or below an average. The chief drawbacks given were blight, the maggot, drought and poor seed. Correspondents about evenly divided in reporting potatoes as either below an average, three-fourths, two-thirds or one-half a crop. A large number referred to the quality as good or fair. Some complained of rot, especially in western sections. Most correspondents referred to the prospect for root crops as being either average, good or fair. Quite a number referred to the crop of apples as better than was expected earlier in the season. A majority, however, referred to it as two-thirds or less; quality a full average. Correspondents in the four western counties where tobacco is grown reported the crop as satisfactory in yield and quality, and that it was curing well. Cranberries averaged small in size, but of generally good quality. The chief drawbacks to the culture were from fire, span and fruit worms, drought, rot in the berry and frost. The peach, quince and grape crops were quite good.

November 1, seventy-three correspondents reported root crops to have been an average, and twenty-three below an average. Fall seeding looking well, especially the early. Potatoes rotting some. Fifty-eight correspondents reported corn to have been among the most profitable crops; forty-one, hay; twenty-one, tobacco; seventeen, potatoes; eleven, apples; eleven, onions; six, cranberries. The good prices received for several crops compensated largely for the small yield. Seventy-five correspondents placed potatoes among the least profitable crops; eight, apples; eight, corn; four, onions. One hundred and three correspondents expressed the opinion that the season had been an average one for profit, and fifteen that it had not. One hundred and six correspondents reported farm stock to be in good or average condition, and six in below average condition.

MASSACHUSETTS CROP REPORTS.

The publication of crop reports was continued as in past seasons, and six monthly bulletins were issued (May–October), aggregating 156 pages of printed matter. Two thousand copies of each issue were distributed. The bulletins were made up as in the season of 1891. The special subjects treated were: Bulletin No. 1, "Farm Help and Wages," and "Weather Forecasts;" Bulletin No. 2, "Frost Warnings;" Bulletin No. 4, "The Horn Fly," "Report on Cranberries." Also this office co-operated with the New England Weather Service in the issuing of weekly Weather-Crop Bulletins. The first was of date of June 14 and the last of date of October 4, — seventeen in all, representing an aggregate issue of 36,600 copies.

PUBLICATIONS.

The following publications were issued under the supervision of this office during the calendar year 1892: —

NAME.	Pages.	Number.	Date of Issue.
Catalogue of Abandoned or Partially Abandoned Farms, second edition, . .	109	1,500	Jan. 22.
Agriculture of Massachusetts, 1891, . .	841*	15,000	Mar. 24.
Crop Bulletin, No. 1, May, ...	28	2,000	June 6.
" " No. 2, June, ...	24	2,000	July 8.
" " No. 3, July, ...	24	2,000	Aug. 6.
" " No. 4, August, . . .	28	2,200	Sept. 7.
" " No. 5, September, . . .	24	2,000	Oct. 7.
" " No. 6, October, . . .	28	2,000	Nov. 5.
Catalogue of Abandoned or Partially Abandoned Farms, third edition, . .	119	2,000	Nov. 26.

* Including Annual Report of Director of State Agricultural Experiment Station, 352 pages.

LEGISLATION.

The legislation of the year 1892 that had reference to the Board of Agriculture or to the agricultural societies was: an act providing for the assignment of police officers for special service at agricultural and horticultural exhibitions (Acts of 1892, chapter 180); an act to establish the salary of the first clerk of the secretary of the State Board of Agriculture (Acts of 1892, chapter 143); an act providing compensation for the members of the State Dairy Bureau (Acts of 1892, chapter 139); a resolve providing against depredations by the insect known as the *Ocneria dispar* or gypsy moth (Resolves of 1892, chapter 5); a resolve providing for printing the special report of the State Board of Agriculture on the work of extermination of the *Ocneria dispar* or gypsy moth (Resolves of 1892, chapter 31); an act relating to the time of marking shade trees for their preservation (Acts of 1892, chapter 147).

APPROPRIATIONS.

OBJECTS FOR WHICH APPROPRIATED.	1890.		1891.		1892.		1893.
	Appropriated.	Used.	Appropriated.	Used.	Appropriated.	Used.	Appropriated.
Bounties to societies, . .	$20,400 00	$19,623 62	$21,000 00	$20,338 65	$21,500 00	$21,352 49	$21,000 00
Travelling and necessary expenses of the Board, . .	1,900 00	1,615 32	1,900 00	1,779 11	1,900 00	1,516 39	1,900 00
Travelling and necessary expenses of the secretary, .	500 00	500 00	500 00	500 00	500 00	500 00	500 00
Incidentals in office of secretary, . .	500 00	500 00	500 00	500 00	500 00	500 00	600 00
Salaries of secretary and clerks, . .	3,700 00	3,700 00	4,372 21	4,372 21	5,600 00	5,600 00	5,600 00
Dissemination of useful information in agriculture by means of lectures or otherwise, . .	2,200 00	2,198 69	2,200 00	2,200 00	2,200 00	2,148 06	2,550 00
Printing 15,000 copies of the "Agriculture of Massachusetts," . .	6,729 37	6,729 37	5,974 00	5,974 00	5,897 58	5,897 58	*6,000 00
Collecting and circulating information relative to abandoned farms, . .	-	-	2,000 00	676 62	†1,323 38	464 88	*1,000 00
Carrying forward work of Dairy Bureau,	-	-	4,000 00	903 05	4,000 00	3,427 51	4,000 00
Salary of assistant in work of Dairy Bureau,	-	-	400 00	400 00	1,200 00	1,200 00	1,200 00
Nails or spikes for marking trees for preservation, .	-	-	100 00	62 69	100 00	48 42	100 00
Printing 5,000 copies synoptical and analytical index "Agriculture of Massachusetts," . .	-	-	-	-	-	-	*1,400 00
Aggregates, .	$35,929 37	$34,867 00	$42,946 21	$37,706 33	$44,720 96	$42,655 33	$45,850 00

* Estimated. † Balance.

Also $75,000 was appropriated to be used in the extermination of the gypsy moth. The unexpended balance of the year 1891, amounting to $5,213.13, was joined to this, making a total of $80,213.13, of which $74,520.96 was used. An appropriation of $165,000 has been asked of the Legislature of 1893.

NAILS FOR MARKING TREES.

By chapter 49 of the Acts of 1891 it was made the duty of the secretary of the State Board of Agriculture to procure and furnish nails or spikes, with a head with the letter "M" plainly impressed upon each, to mayors and aldermen of cities and selectmen of towns, as required by them for the marking for preservation of shade trees within the limits of the highways. The Legislature of 1892 (Acts of 1892, chapter 147) amended the law so that trees may now be so designated during any month of the year. It also appropriated $100 for the supplying of these nails, $48.42 of which amount was expended. Applications for nails were received from the towns of Acton, Barre, Billerica, Bolton, Bourne, Falmouth, Holden, Lancaster, Paxton, Westford and Yarmouth.

GYPSY MOTH (*Ocneria dispar*).

The committee of the Board of Agriculture elected April 28, 1891, has kept steadily at work in the effort to exterminate the gypsy moth. Their report to the Legislature (Senate Document No. 6) will be found printed on pages 259–298 of this volume. At the annual meeting, Feb. 2, 1893, Messrs. E. W. Wood of West Newton and Wm. H. Bowker of Boston were added to the committee.

DAIRY BUREAU.

The Legislature of 1891, chapter 412, enacted a law providing for the protection of dairy products and for the establishing of a State Dairy Bureau. Their report to the Legislature (Senate Document No. 10) will be found printed on pages 299–314 of this volume.

ABANDONED FARMS.

The act authorizing the State Board of Agriculture to collect and circulate information relating to abandoned farms was approved May 4, 1891.

A summary of the work of this office to date shows the following results: Number of abandoned or partially abandoned farms reported to this office, 978; number of owners or agents making reply to our inquiries, 599; number of descriptions of property received, 383; number of owners or agents not desiring to advertise in catalogue, 98; number of owners or agents reporting farm sold in reply to our request for description, 42; number of owners or agents reporting assessors or others to have been misinformed about the property, 76; letters returned by post-office department as unclaimed, 64.

The circulation of the first edition of the descriptive catalogue of abandoned or partially abandoned farms began Dec. 5, 1891. Requests for the catalogue came from nearly every State in the Union, and within two months the entire edition was exhausted. About one-third of the edition was sent to owners or agents of the property described, to assessors, to members of the Board of Agriculture and to officers of agricultural societies. The remainder were sent or given only upon request.

The circulation of a second edition of 1,500 copies of the catalogue began Feb. 1, 1892. Nine new descriptions were included in this edition, making a total of 339. Requests for the catalogue were received from time to time, until by the middle of September the edition became exhausted. The distribution of this edition was very largely by requests by mail and at the office.

Requests for the catalogue still continuing to come, it was decided to publish a third edition. Efforts were put forth to ascertain the results of the work. In the latter part of August a circular was prepared and sent to each person having a description in the catalogue, asking if the farm had been sold, and, if sold, the name and address of the buyer and also the use he proposed to make of it; if not sold, whether it was desired to have the description appear in the third edition. This request was in some instances made three times. Up to November 10, returns were received concerning 251 of the 339 farms described in the catalogue. Of these, 51 were reported sold; 22 owners wished to have description withdrawn, and 178 owners wished description continued in the third edition. Nothing was heard concerning 88 farms. Of the 51 farms reported sold, 5 are in

Berkshire County, 1 in Bristol County, 1 in Essex County, 5 in Franklin County, 7 in Hampden County, 7 in Hampshire County, 3 in Middlesex County, 1 in Nantucket County, 3 in Norfolk County, 5 in Plymouth County and 13 in Worcester County. Of the 22 farms withdrawn, 1 is in Barnstable County, 4 in Berkshire County, 3 in Franklin County, 3 in Hampshire County, 2 in Middlesex County, 2 in Plymouth County and 7 in Worcester County. Several who wished description withdrawn stated that they expected to sell the farm at an early date, and therefore did not wish to have the description continued.

It is noticed that a large majority of the purchasers of the farms sold are of American parentage. Thirty-two of the purchasers were residents of Massachusetts at the time of purchasing, 1 of Nova Scotia, 1 of Illinois, 1 of Florida, 1 of Ohio, while the residence of 15 has not been reported. Eighteen of the farms sold were reported as sold for farming purposes, 2 for farming purposes and poultry raising, 3 for poultry raising, 1 for poultry raising and market gardening, 2 for sheep raising, 2 for summer residences, 7 for homes, 1 for the timber on it, 1 for stock raising, 3 as an investment, while the intentions of 11 purchasers have not been obtained. Forty-four additional descriptions were received and incorporated as an appendix to the third edition, making the total number of farms described 383.

By the State census of 1885 there were 45,010 farms in the State, representing a total acreage of 3,898,429¼; average acreage, 86.61; total value of land and buildings, $185,118,925; and average value of land and buildings, $4,112.83. The total acreage of the 383 farms advertised in the catalogue is 42,955; average acreage, 112.15; total amount asked for the farms, $633,725; and average amount asked for the farms, $1,654.63. The total acreage of the 51 farms reported sold is 4,506, or an average acreage of 88.35¼. The 51 farms sold for a total of $75,550, or an average of $1,481.37. One farm sold for $250, two for $325 each, one for $400, one for $450, two for $500 each, six for $2,000 each, one for $2,500, one for $2,700, one for $2,750, three for $3,000 each, one for $3,500, one for $4,500, one for $5,000, while the prices of the remainder ranged from

$500 to $1,800. In size one was a farm of 4 acres, another of 6 acres, two of 16 acres, one of 200 acres, two of 225 acres, one of 280 acres, while the remainder ranged from 18 to 175 acres. Twenty-two were 100 acres or over.

To date $1,141.50 of the $2,000 appropriated by the Legislature of 1891 has been spent, — wholly for printing and postage. As this appropriation of 1891 expired by limitation Jan. 1, 1893, a further appropriation of $1,000 has been asked of the Legislature of 1893 for the continuation of this work.

Two thousand copies of the third edition were issued Nov. 26, 1892, and eight hundred copies remain undistributed.

That this effort to secure the reoccupancy of our abandoned or partially abandoned farms has met with an appreciative reception is evident, and it is believed the results will be to the advantage of the State.

Agricultural College.

The report of the examining committee of the Agricultural College will be found printed on pages 363–368.

Returns of Societies.

These returns will be found printed on pages 317–348 of this volume. It will be noticed that these returns are arranged as last year. A summary is printed on page 348, contrasting the totals of 1892 with those of 1891. The returns of 1892 showed a much greater degree of carefulness on the part of the officers of the societies than has been true in past years.

Farmers' Institutes.

The societies held one hundred and thirty-three institutes in 1892. The places, dates and subjects will be found printed in the returns of the societies. A provision of the law enables this office to supply speakers for institutes. During the year 1892 this office furnished speakers for seventy-eight, at an expense of $662.39. The Board, at its annual meeting in February, 1892, directed the executive committee to arrange for a circuit of institutes, one for each society, to begin after Jan. 1, 1893. This has been done, and most of the societies have had one of the circuit institutes. John E. Russell has spoken at three, Dr. Geo. M. Twitchell of Maine at five, A. J. Rider of New Jersey at two, J. H. Hale of Connecticut at five, Major H. E. Alvord of Washington, D. C., at five, and W. W. Rawson at four. Most of these circuit institutes have been well attended and had interesting discussions. The same plan will be followed in 1894.

Agricultural Directory.

A directory of the agricultural organizations, with officers for 1893, has been prepared, and will be found printed on pages 427–441. It is desired that this office be notified of subsequent changes in the officers of these organizations.

Meetings of the Board.

The public winter meeting of the Board for lectures and discussions was held at Spencer, Dec. 6, 7 and 8, 1892. The meeting was in all respects a pronounced success. The lectures and discussions will be found printed on pages 9–257 of this volume. The annual meeting of the Board for the transaction of business was held at the office of the secretary, Jan. 31 and Feb. 1 and 2, 1893, and the minutes thereof, reports adopted and essays read, will be found printed on pages 351–426 of this volume.

Changes in the Board.

During the past year the following changes have taken place in the personnel of the Board: His Honor Wm. H. Haile, a member *ex officio* for three years, ceased to be lieutenant-governor and consequently a member of the Board of Agriculture; Mr. P. M. Harwood of the Worcester County West Society, after two years' service, resigned to accept the chair of agriculture in the Michigan Agricultural College; Mr. Geo. H. Gardner of the Nantucket Society, after two years' service, resigned on account of ill health. The following gentlemen retired from the Board because of the expiration of their term of service: Mr. J. D. Avery of the Deerfield Valley Society, after three years of service;

Mr. B. P. Ware of the Essex Society, after fifteen years of service; Mr. Hiram Taylor of the Highland Society, after three years of service; and Mr. S. B. Bird of the Middlesex South Society, after twelve years of service. Death has claimed no members during the year.

Appendix.

In the Appendix will be found a report of the National Farmers' Congress at Lincoln, Neb., Nov. 22–24, 1892, made to His Excellency the Governor by Hon. Daniel Needham of Groton. This report was transmitted to the secretary of the Board of Agriculture by His Excellency the Governor, with the request that it be included in this volume.

In the Appendix will also be found the Annual Report of the State Cattle Commissioners (Senate Document No. 5).

WM. R. SESSIONS,
Secretary of the State Board of Agriculture.

Boston, February, 1893.

MEETINGS OF THE EXECUTIVE COMMITTEE

OF THE

BOARD OF AGRICULTURE.

1892.

MEETINGS OF THE EXECUTIVE COMMITTEE OF THE BOARD.

Boston, March 16, 1892.

Notice was received from the secretary of the Commonwealth that on the 24th of February, 1892, Dwight A. Horton of Northampton was appointed and commissioned, and on the 2d day of March, 1892, was duly qualified, as a member of the State Board of Agriculture.

Boston, April 18, 1892.

A communication was received from the secretary of the Worcester County West Agricultural Society, announcing the election of Mr. E. A. Harwood of North Brookfield delegate to the Board, in place of Mr. P. M. Harwood, resigned.

Mr. W. A. Kilbourn of South Lancaster was chosen a member of the examining committee of the Agricultural College, to fill the vacancy caused by the resignation of Mr. P. M. Harwood.

Voted, That an excursion to Amherst for Massachusetts farmers and others interested in the Agricultural College be arranged for commencement week in June, 1892.

Voted, That the secretary notify the members of the executive committee of any hearing that may be advertised by the committee on administrative boards and commissions of the Legislature, upon the reorganization of the State Board of Agriculture, and that it be the duty of the executive committee and the secretary of the Board to attend such hearing if advertised, and represent the Board thereat.

BOSTON, May 10, 1892.

The executive committee authorized the Attleborough Agricultural Association, on its request, to change the date of holding its 1892 fair from September 20, 21 and 22, as established at the annual meeting of the Board, to September 13, 14 and 15.

BOSTON, May 28, 1892.

On request of the Worcester Agricultural Society, it was voted to approve the mortgage of the society's property to an amount not exceeding six thousand dollars, and the secretary was instructed to notify the society of this action.

BOSTON, June 18, 1892.

The executive committee authorized the Middlesex South Agricultural Society, on its request, to change the date of holding its 1892 fair from September 14 and 15, as established at the annual meeting of the Board, to September 7 and 8.

BOSTON, Aug. 5, 1892.

Notice was received from the secretary of the Nantucket Agricultural Society that Mr. John Harps had been chosen delegate to the Board until their annual meeting, in place of Mr. George H. Gardner, who had resigned on account of ill health.

BOSTON, Aug. 17, 1892.

The executive committee authorized the Amesbury and Salisbury Agricultural and Horticultural Society to change the date of holding its 1892 fair from September 27, 28 and 29, as established at the annual meeting of the Board, to October 4, 5 and 6; and the Essex Agricultural Society to change the date of holding its 1892 fair from September 20 and 21 to September 27 and 28.

BOSTON, Oct. 26, 1892.

Voted, That the secretary be authorized to engage Dr. J. B. Lindsey to present a paper at the annual meeting of the Board

Voted, That the secretary be instructed to arrange a circuit of institutes, as voted by the Board, the societies to be placed in seven groups or circuits, as follows: —

1.	Nantucket, Martha's Vineyard, Barnstable, Plymouth, Weymouth,	Subject: Cranberry Culture.
2.	Bristol, Attleborough, Marshfield, Hingham, Essex,	Subject: Poultry.
3.	Amesbury and Salisbury, Middlesex South, Middlesex, Middlesex North, Worcester,	Subject: Market Gardening.
4.	Hoosac Valley, Berkshire, Union, Eastern Hampden, Spencer,	Subject: Horses.
5.	Housatonic, Hampden, Hampshire, Franklin and Hampden, Hampshire, Franklin,	Subject: Cultivation of Tobacco.
6.	Worcester North, Worcester North-west, Oxford, Blackstone Valley, Worcester East,	Subject: Cultivation of Fruit.
7.	Highland, Hillside, Deerfield Valley, Worcester South, Worcester County West,	Subject: Dairying.

Voted, That the secretary have power to change the composition of the circuits, to secure speakers, and to arrange dates with the several societies.

PUBLIC WINTER MEETING

OF THE

BOARD OF AGRICULTURE,

AT SPENCER.

December 6, 7 and 8, 1892.

PUBLIC WINTER MEETING OF THE BOARD,

AT SPENCER.

By invitation of the Farmers' and Mechanics' Association of Spencer the stated annual winter meeting of the Board was held in the town hall of that busy and prosperous place, beginning on Tuesday, December 6, and continuing through the two following days. The attendance was quite large at the opening session, and a lively interest was manifested in the papers which were read and the discussions which followed them from the beginning until the close of the meeting.

Shortly before 10 o'clock on Tuesday morning, Secretary Sessions called the meeting to order and said: —

The hour has passed at which this meeting was to convene, and it is best not to wait longer. We are favored with a pleasant morning, and I hope the meeting may be a success. I have no doubt it will be. For thirty years the Board of Agriculture has had a public winter meeting of this character, and the results have been such as to lead the Board to continue in its former practice. I have no doubt that this meeting will be one of the best.

But it is not my business to make a speech to you. The meeting will be opened by prayer, and Mr. Avery will welcome you here in behalf of the Spencer Farmers' and Mechanics' Association and of the people of the town. The Hon. James S. Grinnell, our senior member, will respond for the Board and preside this morning. The Rev. Thomas O. Marvin will offer prayer.

Prayer having been offered, John G. Avery, Esq., of Spencer, addressed the audience as follows: —

ADDRESS OF JOHN G. AVERY.

Gentlemen of the State Board of Agriculture:—It is a very great pleasure to me to welcome my late colleagues to the town of Spencer, nestled among the hills, surrounded by a wealth of agricultural interests, and near enough to the heart of the Commonwealth to be affected by its magnetic influence. Spencer is a historical town. In the early days of the nation's struggle for independence she furnished a company of minute men well drilled and equipped for the campaign, who responded promptly to the call "on to Concord." Washington in his journey to New England in 1779 rested for the night at the Jenks tavern on the site of the present Massasoit hotel. Nothing of interest is recorded of his visit except that he complimented the landlady for her excellent bread, which compliment was her boast for ever after. There is a fine specimen of an old colonial homestead in a good state of preservation, within a few rods of this hall. It was built in 1745 by the Rev. Joshua Eaton, the first minister settled in Spencer, and the title has been in the family of the present owner since 1776. There are many relics of the last century to be seen within its walls. The first wire drawn in the United States materialized in Spencer. The first shop for the manufacture of what were known as sale boots was established in Spencer in 1812 by Josiah Green. A few years later Isaac Prouty established a shop in the north part of the town. Elias Howe, the inventor of the sewing-machine, was born in Spencer. By his invention woman has been emancipated from the slavery of the needle, and Hood's "Song of the Shirt" relegated to innocuous desuetude. We are an industrial people. Here you will hear the click of the sewing-machine and shuttle vieing with each other in producing our commercial products, while the monotonous wire drawer is making merry with his long-drawn metallic yarns, and the farmer is making special efforts to supply the wants of the operatives.

Spencer is a picturesque town, with hills and dales and flowing streams, and every prospect pleasing. Green meadows, flanked by young forests, where in the harvest season the click of the mowing-machine hustles the woodchuck to his lair, while the robin chants music to the beat of the hay tedder. Many of our farm-houses and the surrounding grounds are examples of neatness, taste and thrift. Here you will find plants and flowering shrubs in profusion, wafting their sweet fragrance into the open window where the good housewife is preparing the midday meal, and singing sweet lullabys to the sleeping infant in the cradle, the joy and hope of the household.

To-day we have the largest manufactory of footwear in the world, with five others of no small pretensions. Their united output amounts to three and one half millions of dollars per annum. In 1860 the boot product amounted to $682,000. We have four woollen mills that average 80,000 yards of cashmere per month, and the wire mills make four tons of wire per day.

Our schools are second to none in this Commonwealth. We have six brick school buildings of four rooms each, two wooden structures of two rooms each and eight of one room each. A modern high-school building was built in 1888, at a cost of about $50,000, and presented to the town by the late David Prouty. There are at the present time about 1,900 registered pupils attending school, besides an average attendance of 135 pupils at a night school, all under the charge of an efficient superintendent and an able corps of teachers, while the school committee assumes a general oversight. A free public library and reading-room, costing $30,000, was a gift to the town by our esteemed citizen, Mr. Richard Sugden. It contains 10,000 volumes of standard literature. Our public park, containing about fourteen acres, laid out in drives and walks, and bordering on a lake of pure water, is a favorite resort during the summer months for our citizens and those of neighboring towns. This park was a gift to the town by Luther Hill, Esq. The Spencer Farmers' and Mechanics' Association received from Nathaniel Myrick, Esq., substantial aid when it was first formed, giving an impetus to the enterprise which has brought it to its now prosperous condition; and the park, containing about thirty acres, where the association holds its annual fair, bears his name, Nathaniel Myrick Park.

The subject of better roads has been discussed by your honorable body, and it seems that throughout the Commonwealth there is an increasing demand for improved roads. Spencer has made a commencement which is worthy of your inspection. It is nothing new, but the macadam system has been adopted, and it has demonstrated what can be done in towns where there is plenty of proper material.

I should be remiss in my duty did I not call your attention to our churches, — models of the architects' and artists' skill, with their towering spires beckoning us to a higher and more exalted sphere.

Gentlemen of the State Board of Agriculture, in behalf of our citizens I welcome you to our town and all its attractions, and may your deliberations prove of incalculable benefit to our farmers and citizens, and add further laurels to those already won by the honorable State Board of Agriculture.

RESPONSE ON BEHALF OF THE BOARD.

BY HON. JAMES S. GRINNELL.

The committee of arrangements for this meeting have requested me to briefly return the thanks of the Board of Agriculture to the people of this town for the opportunity to visit this part of Worcester County and to make a partial acquaintance with its farmers. The credit of this is largely due to the energetic and persuasive efforts of the recent earnest and effective member of our Board from this society, — John G. Avery, Esq.

The Board of Agriculture, composed as it is of delegates from every incorporated agricultural society in the Commonwealth, has now held thirty winter meetings in the different parts of the State, but none I believe in this immediate locality. The Board was induced to accept your invitation partly on this account and also because this is the centre of a large and thriving agricultural district. This has been a prosperous community for a hundred and fifty years. It was prosperous long before the influx of the active manufacturing industries which have made it so conspicuous and wealthy. Here were enterprising and prosperous farmers, with abounding crops and profitable dairies, and here many of them remain, — enough to form an active agricultural society under the patronage of the State.

The members of the Board have of course the interests of the farmers at heart, and endeavor in every way to promote those interests, by these meetings, by the farmers' institutes, and, what is most important, by directing and assisting State legislation for their protection and advancement. All the acts of the Legislature in aid of the farmers have been prompted and forwarded by this Board. We believe our action has been appreciated by the farmers, and that this very successful meeting is an evidence of that appreciation by the members of the Spencer Farmers' and Mechanics' Association.

For some reason Mr. CHEESMAN, who was to address us first this morning, has not arrived. Until he comes, Mr. SESSIONS, the secretary, will take up a different subject for a few moments, one which cannot but interest you all, — the subject of roads and highways.

Secretary SESSIONS. I received a note from the editor of "Good Roads" in New York a few days since, asking me to give my views upon the subject of roads from the standpoint of a farmer. I replied to him, and the points I made are somewhat familiar in my mind, though I may be obliged to give them in a desultory manner.

I have been surprised at some of the propositions put forward by many of those in favor of good roads. Their projects seem to be rather chimerical in view of the condition of the rural districts of the Commonwealth. The construction of stone roads has been strongly advocated, and their advantages clearly and forcibly presented; but, when we consider the taxable valuation of small towns, we can see that the building of stone roads is entirely beyond their power. Take, for instance, the town in which I live, — not a poor town by any means. Our valuation is about $400,000. Stone roads cost, according to the quality, from two thousand to ten thousand dollars per mile. We have fifty miles of roads in our town. Now, a little computation will show that, even at the rate of $4,000 per mile, which is a cheap rate for stone roads, it would take just one-half the valuation of our town to put in stone roads in place of those we now have. If we were to attempt to accomplish it in detail, and should undertake to make one and a half miles of stone road per year, it would take thirty-three years to complete the task, and the cost of the one and a half miles of stone road would oblige us to more than double our present tax rate. So that it would take thirty-three years of double taxation to make these roads in our town. Now, there are dozens of towns among our hills whose valuation is less and whose road mileage is more than that of our town. So you see the impossibility of undertaking to do anything of this kind without State aid. There are those who are in favor of State aid; there are those who are opposed to it, believing in the old idea that towns and communities should take care of themselves.

I have some ideas which have occurred to me on this subject, which I will suggest to you. One is, that the State might undertake to build a road connecting each town with its natural market or its most eligible railroad station. Those roads would not only be valuable in themselves to the community, but would be an object lesson to the towns, and if the cost, the system upon which they were made, and the reasons for the plan being adopted for that location were reported in detail, the towns could see what they could afford to do in that line upon the remainder of their roads. It seems to me that along with this policy should come a system of bounties or gratuities offered by the State, to induce the towns to do something in this line. For instance, suppose the State should say to the towns, by legislative enactment, "If you will build one mile of road to the acceptance of the State engineer, the State will build another in your town." Or, if it is thought that the State could do the work better than the towns, the State might say to the towns, "If you will appropriate money sufficient to build one mile of stone road, the State will build two miles, or in that proportion." I believe in State aid; I do not believe in laying all the burden on the towns; and I think that something of that sort has got to be done.

Along with this there should be provision for the appointment of an engineer to go out to any town and make plans and specifications for a proposed road, and estimates of the cost in detail. Such roads, built under the direction of a thoroughly competent engineer, would, of course, have a properly graded and thoroughly drained road-bed, and they could use such material as was best under the circumstances. An excellent road can be built by thoroughly draining the bed and applying from six inches to a foot of good gravel. Many of our towns have a convenient supply of good gravel, and where that is plentiful the engineer could order it to be used. If that is not accessible, broken stone could be used, and perhaps would be economical.

These are some of the crude thoughts that have occurred to me in regard to the improvement of the roads in our State. The only way we shall ever accomplish anything is by discussing the matter, by getting the ideas of one man and rubbing them against the ideas .of another, and perhaps we may get the best plan from the man of least experience.

I see that Mr. CHEESMAN has come in, and we will take up the subject assigned for this morning.

The CHAIRMAN. I think that we will consider this subject of road-making which Mr. Sessions has opened as laid upon the table. It may be taken up again whenever there is opportunity.

You are now invited to listen to a lecture on "Home-grown or Purchased Cattle Foods," by Prof. JAMES CHEESMAN of Southborough, a man whose name only needs to be mentioned to insure attention anywhere in Massachusetts on any subject connected with the dairy.

Professor CHEESMAN. When our secretary did me the honor to invite me to present the subject of cattle foods to you this morning, I was in doubt whether to treat it from the stand-point from which I am accustomed to consider it in addressing agricultural societies and farmers' institutes, that is, a local stand-point, or from the stand-point of general principles. Inasmuch as this is a meeting of the State Board of Agriculture, what I shall ask you to consider this morning applies not to any particular county merely, but to the whole State of Massachusetts and inferentially to all of New England. I have chosen to treat the subject from the stand-point of general principles, introducing only here and there figures illustrating the question of cost relating to various localities in New England, parts of New York State and Canada.

HOME-GROWN OR PURCHASED CATTLE FOODS.

BY PROF. JAMES CHEESMAN, SOUTHBOROUGH.

The history of farming in Massachusetts is the history of migration of the rural population, and the transformation of industries.

From necessity the Bay State farmer early became an intensive cultivator. The physical conformation of his land and its rocky surface have compelled him to limit the area of tillage.

In every system of farming well-kept grass land and a large proportion of the cultivated area maintained in grass have formed the foundation of animal industry. Inasmuch as we must all have grass land for hay, it is important to consider how much land we should use, and what quantity and quality of herbage we should produce.

I have never known a successful farmer who could not manage well his grass lands. The conclusion is forced on us that every cattle man who has achieved distinction as a cultivator won it by learning how to grow for the least amount of money what is admitted to be the costliest ingredient of an animal's ration. In a mixed ration it is usual to figure the cost of hay at the ruling prices in towns and cities, and to value it for what we get out of it in comparison with the yield of such concentrated feeds as new-process linseed meal, cotton-seed meal, bran and other cattle foods. The value of the several components of these substances determines for us the relative value of hay. Calculated by any process of reckoning, we must acknowledge that hay is costly; we cannot argue against the hay crop because it is costly. The lesson suggested is rather reduction of cost, and such a management of grass lands as to enable us to grow the largest yields per acre at the least cost.

Next to a careful selection of seed of known vitality and proper variety, the preparation of the seed-bed and its thorough treatment are of paramount importance. The assumption that grass crops will take care of themselves is too common among us. There is no essential difference between the food wants of the plants which compose our grasses and the nutritive requirements of the tillage crops. When we harvest good crops of oats, corn or potatoes, it is because we have fertilized them generously. The law of life which so closely connects efficient nutrition with large milk, egg and meat yields in animals is the same for plants. If the grass crop could have as much attention as the corn and potatoes, it would yield as liberally in proportion.

Nitrogenous Plants. — Grain Rations.

A great deal has been said, during the past two years, of the need of growing more nitrogenous plants. This advice has been urged as an argument for lessening the outlay for such purchased feeding stuffs as we buy from Western growers, whether in the form of bran or corn meal. I don't think the time is near when it will be economical to stop buying cotton-seed meal or linseed meal. These two substances form the very cheapest sources of nitrogen purchasable by farmers. The largest and most prosperous milk producers in our State are the men who use most liberally and intelligently mixtures of these two substances. I would therefore start out with this rule for feeding: A mixture of cotton-seed and linseed meals in equal weights; that these foods should form from three to four tenths by weight of a mixture of other grains, as bran, oat feed, corn or cob meal, and middlings; that the cotton-seed and linseed fed to cows should equal one-eighth of the weight of milk. Thus, a cow giving twenty-four pounds of milk daily should have with other grain three pounds of these two. Another giving forty pounds daily should be able to eat five pounds of this grain. A cow producing that quantity of milk, if not more than twelve and a half per cent of dry matter, produces five pounds of dry food. No beef animal ever produced such a yield of dry meat. The income and expenditure is a liberal one.

Everything depends on High Feeding.

Everything depends on this mode of high feeding of animals, with special reference to the value of manurial residues. This is the key-note of feeding on two of the most interesting farms in Southborough. On one farm about four tons of hay to the acre are grown, and no succulent food of any kind. On the other no hay is grown, but the animals are kept to make manure to feed garden crops designed for the Boston market. In the human and all animal life we rightly regard the complexion — its touch, color and general tone or appearance — as the best expression of health. In plants we do not attach enough importance to shade of color, touch, tone and general appearance; and yet all these features are powerfully affected for good or ill by the amount of nutrition they obtain during their growth. Everyone knows there is a great practical value in a lusciously ripe orange; a mellow, richly scented pear; in the color, ripe flesh and delicate aroma of an apple, apart from their æsthetic features. Can anyone calculate the value of these things in promoting digestion? We all accept as true the proposition that digestion governs nutrition, and that unless we digest what we eat we get no nutriment from our food.

Two Examples.

These two instances of diverse farming in the town of Southborough illustrate principles of manuring which determine how animals shall be fed and what forms of fertility shall be bought. The one farmer has concluded that, as milk is his primary product, hay is the best and cheapest food he can grow on the farm for foundation fodder. Who shall say that the nutritive value of such hay is not much greater than the ordinary article? and, judging it on the basis of color, tenderness of fibre, scent and flavor, it ought to be reckoned the best in our town. On this farm I have seen the hay crop increased and improved by the use of linseed and cotton-seed meals; about twenty to twenty-one cows are milked, and the owner and one hired man do the labor with two horses.

On the other farm about thirty cows are in milk; all the hay is bought, at about fourteen dollars to fifteen dollars per ton; and a mixed grain is fed, composed of highly nitrogenous feeding stuffs. The milk pays for the feed and labor and a small margin over. The farm is a small one, and is given up to the cultivation of garden crops entirely. The owner's estimate of income is about ten cents' worth of manure per animal daily, or three dollars a day. The manure from these cows is therefore the primary consideration of this dairy.

I have endeavored to enforce the primary need of buying in the cheapest possible form the necessary plant food to maintain the fertility of the farm. With the same investment in land, animals, labor and tools, land so managed will give an increased yield of fodder with which to produce more milk, without adding to the expense of attendance, hauling or otherwise.

How shall Grass be Maintained?

The question now presents itself, How shall grass be maintained without too often breaking the soil for seeding? In relaying the grass land, what crop shall we plant, and how long shall we crop before reseeding? On general principles, it is perhaps best to lay down the rule that all land should be reseeded to grass after two years of hoed crops. My own preference is corn on sod, followed by a root crop. This permits of thorough cleaning on land that can be easily worked, and yields two of the most useful crops to a dairyman. Variety of plants is nature's favorite combination for sustaining animals, when grass is the exclusive food. In winter we can hardly have too great a variety of fodder with which to mix our grain substances. The more varied an animal diet, the more agreeable; and agreeableness is a great factor in the digestion of food. How much corn, what kind, how it shall be planted, and what disposition shall be made of it when harvested, are questions which each must solve for himself, after fully considering his circumstances.

ENSILAGE.

No better use can be made of the corn crop than its conversion into ensilage. I have never known of a case of silage practice being abandoned after three consecutive years of trial. Figured on the most expensive way of calculating cost, by charging up all of the manure and commercial fertilizer used on a crop, I cannot make it cost more than two dollars and seventy-five cents per ton, packed in the silo. Three tons of such ensilage are worth one ton of hay. In Southborough the ensilage has no saleable value off the farm, while hay may be sold at from fifteen to eighteen and twenty dollars per ton. Any land that will grow two tons of hay per acre will raise at least twenty tons of ensilage corn, or about two and a half times the dry matter of hay. Manifestly we cannot grow any cheaper food on a Massachusetts farm than ensilage corn, or some of the northern varieties of yellow corn. What is true of our condition is true also of the other New England States and New York. In the East oat feed in all forms is expensive, even when grown on the farm; if sold, an oat crop would realize a good price. In seeding down to grass, an oat crop might very properly be taken as a catch crop, and be converted into oat hay; or a crop of peas and oats might be planted, to still further vary the winter bill of fare for the cows. The oat crop is a most valuable adjunct to the feeder's resources. There is a combination in the oat plant which adds much to the flavor of milk, its cream and butter. Animals eating it are improved in health, and give a more alkaline milk, which keeps longer and is more digestible than the ordinary kinds met with in the market.

The question of cost of farm crops in the West is so often raised that it may be well to present in detail the figures relating to the corn crop in Iowa, as that is the staple grain production of the State. According to the latest and most reliable information published by the Bureau of Statistics of Iowa, the average cost of an acre of corn in the ninety-nine counties is $10.33, or 30 cents per bushel. This includes shelling and marketing. Less shelling and marketing, the figures are $8.59, as shown in the following table: —

Cost of an Acre of Corn in Iowa.

Interest 8 per cent or rent,	$2 55
Taxes,	34
Crib room,	22
Ploughing,	1 13
Harrowing twice,	27
Seed corn,	12
Planting,	25
Cultivating three times,	1 14
Fertilizing,	88
Cutting stalks,	22
Husking and cribbing,	1 28
Fencing and repairs,	19
Total,	$8 59
Per bushel,	25

As very few Iowa farmers count the value of fodder, we may well pass over it as of little account to them. Let us see what it costs to grow an acre in Massachusetts, and ask ourselves what it is worth on the farm. We shall then see how far the low cost of production in the West is an advantage to us. I doubt whether any farmer in Massachusetts can grow corn for less than $45 an acre. I know of cases of higher cost, but they represent the highest practice. Suppose we take $60 as the cost of our acre, — and that is much beyond the actual facts; what have we?

One hundred bushels of ear corn,	$45 00
Four tons corn stover,	20 00
Total,	$65 00

The value of our 100 bushels of ear corn and the value of the corn stover must be set against the value of an acre of pasture, and say two and a half tons of corn meal, plus the cartage. If we calculate the value of corn meal at an average of $22.50 in ordinary years, we can see at a glance that we receive a much greater return from the home-grown acre. I have assumed that the quality of the bought meal is equivalent to that grown on the farm, — an assumption rarely borne out in practice.

The oat crop in the West will cost about the same as the corn crop. In the East we add to the value of the grain the market price of the straw, which materially reduces the cost. It must also be borne in mind that the labor charges in the East are over-estimated, since most of us would use labor employed for stock and general farm work; whereas in the West labor is employed primarily for grain growing.

Again, while it is shown that the cost of growing the corn is about 25 cents per bushel, the bulk of the crop is sold at 18 cents, or below cost; unless we treat the stover as gain. It is estimated that 7 bushels are sold at the minimum price of 18 cents, against 3 bushels at 42 cents, or the maximum market quotations. While in reality the average return to the farmer is about 25⅕ cents, the average of the two extremes is 30 cents. The increased appreciation of grain feeding in the West has already increased the cost of bought grain and millstuffs in the north-western States; and their farmers are growing more peas and oats. It is doubtful whether we shall again be able to buy corn and millstuffs as cheaply as during the last ten years. Wherever other circumstances render it possible, every Eastern farmer should try to replace part of his corn meal and millstuffs by home-grown crops.

If we attempt to compare the value of the corn ensilage crop, let me offer you a comparison obtained from the most costly acres I have experience of. In the county of Worcester 7 acres of ensilage corn cost in the season of 1890 $515.50, or $73.64 per acre in the silo. Figuring the dry matter at only 25 per cent, the cost of the ton of dry food material was $11.78, on a yield of 25 tons per acre; or $2.94½ per ton of ensilage. Inasmuch as the dry matter of the ensilage was nearly all digestible, it would be hardly fair to take the dry matter in the corn meal at the same value. Let us give the corn meal the benefit of the difference, and call the values the same. Corn meal at $22.50 a ton contains about one-seventh its weight in water, or, in other words, its dry matter costs about $25.60, — just about double the cost of the dry food material in our expensively grown ensilage crop.

COST OF GRAIN ON NEW ENGLAND FARMS.

	OAT CROP.	OAT CROP.	CORN CROP.
	W. D. BAKER, New Hampshire.	JOEL RICHARDSON, Maine.	THOMAS DAGGETT, Maine.
Rent and taxes, .	$3 00	$3 00	$3 00
Ploughing, . .	2 00	1 50	3 00
Manure, . . .	5 00	6 00	10 00
Seed, . . .	1 50	1 25	75
Fertilizer, . .	–	–	6 75
Harrowing, . .	1 00	1 00	2 00
Seeding, . .	15	20	1 00
Rolling, . . .	75	75	–
Hoeing, . . .	–	–	3 00
Cultivating, . .	–	–	8 00
Cutting, . . .	75	75	–
Harvesting, . .	–	–	6 00
Threshing, . .	2 50	2 50	–
Teaming, . .	1 00	1 00	–
Labor, $1.25.	$17 65	$17 95	$43 50
Yield, 40 bushels.	–	42 bush.	15 tons.
Less 1½ tons straw,	9 00	9 00	–
	$8 65	$8 95	–
Net per bushel, .	21$\frac{6}{10}$	–	$2.90 per ton.

Cost of Cropping.

By Simpson Reume, Gold Medalist Farmer, in Canada.

	Mangolds.	Barley.	Hay.	Peas.	Wheat.	Oats.
Rent or interest, . .	$5 00	$5 00	$5 00	$5 00	$5 00	$5 00
Ploughing, . . .	3 00	1 50	–	2 00	3 00	3 00
Manuring, . . .	20 00	–	–	–	–	–
Harrowing, . . .	50	50	–	70	70	50
Rolling, . . .	15	15	–	15	15	15
Seed, ...	60	1 00	–	1 50	1 50	90
Planting, May 10, .	20	10	–	30	30	30
Thinning and hoeing, .	3 00	20	–	20	20	20
Scrubbing, . . .	40	–	–	–	–	–
Cultivating, . . .	60	30	–	–	30	30
Harvesting, . . .	3 50	2 00	3 50	2 00	2 00	2 00
Threshing and cleaning,	–	2 75	–	2 75	2 75	2 75
Grass seed, . . .	–	–	1 25	–	–	–
Making hay, . .	–	–	1 25	–	–	–
Yield per acre, .	$36 95	$13 50	$11 00	$14 60	$15 90	$15 10
		45 bus.	1¾ tons.	36 bus.	28 bus.	60 bus.

Value of straw not stated.

THE LARGEST FOOD YIELD AT LEAST COST.—THE MANURE PILE.

For a number of years Eastern farmers have been told that it did not pay to grow this or that cereal crop, and it was cheaper to buy all grain supplies from the West or from whoever will sell us. Our chief difficulty in grain growing is the soil limitation imposed by the physical condition of our farms. Wherever land is available for growing corn and potatoes economically, we may properly consider whether we may grow part of the more carbonaceous components of our grain ration. Land yielding two tons of hay, twenty tons of fodder corn, or two hundred and fifty to three hundred bushels of potatoes to the acre, may be counted on for a paying crop of oats or oat fodder, the aim under all circumstances being to produce the largest food yield at the least cost. If the land is available it is quite possible to produce shelled oats at twelve to fifteen dollars per ton, and sell the straw at a good price.

The success of any system of farming in which live stock forms the central feature is based upon the manure pile. The character of it, its amount, and the cost of getting it to the fields, decide the kind and quality of farming that may be practised. Our labor rates are relatively high, but not higher than those paid in the West, while it is vastly more efficient. If the grain bill is but a dollar a day, it must be obvious that any economy would be welcome. On farms buying one thousand dollars' worth a year of grain, a saving of only ten per cent is a respectable sum. The purchase of the higher forms of nitrogenous cattle foods, and their conversion into animal products and plant food for the sustenance of new crops to be fed to more live stock, illustrate the cycle of equivalence on which all economical agriculture is based.

THE LESSONS OF HARMONY.

It was Rumford who said, "The number of people who may be supported on a given area of land depends as much upon the art of cookery as upon the art of agriculture." The modern practice of blending feeding substances in almost endless variety for the attainment of the same results sought by the economical housekeeper may very properly be regarded as an equivalent of cooking for cattle. The object in either case is economy of raw material attained by increasing the enjoyment and digestibility of food material. If the endless preachings of economical farming do not suffice to awaken the latent powers of the husbandman, how shall we hope for better things by appeals to art? If the changing foliage has a language, the singing birds a message, the bursting buds and opening blooms a voice whose tones and meaning admit of no misunderstanding, it must strike some of us as wonderful that their lessons in harmony are not more fully appreciated and heeded in adjusting our relations to the needs and opportunities of our lives.

The Chairman. Gentlemen, an opportunity will now be afforded for a discussion of the important subject which has been considered in the interesting lecture to which you have just listened. The discussions are the most valuable part of these meetings, because in them are presented the impressions and opinions of the men who have tried these things and who give their experience. You are now at liberty to question the lecturer upon any points in his discourse upon which you want further explanation or further elucidation. Professor Cheesman will be very ready to answer any question.

Prof. I. P. Roberts (of Cornell University). I would like to ask the speaker if he would recommend that the farmers of Massachusetts raise their corn and nitrogenous foods, or that they purchase them largely?

Professor Cheesman. I have recommended both in the paper, with this qualification, that, wherever land is available for growing crops, that is, arable land, we should take off a crop of oats in the course of our rotation. As a matter of fact, we do all purchase very largely the nitrogenous foods. I suppose, per acre, per cow and per quart of milk raised in the State of Massachusetts, we purchase more cotton-seed meal, linseed meal and gluten meal than any other State in the Union, — and rightly, because we have the very best market in the world. We have in the city of Boston certainly a better market and get better pay for our dairy products than in any other city.

Professor Roberts. I believe you are making the same mistake in Massachusetts that we are making in New York; and it is the same mistake that a man would make if he got a cow and did not know how to milk her, and then should go down town and buy concentrated milk. He had better learn how to milk the cow and make use of his own resources. The yield of corn per acre in Massachusetts is considerably higher than it is in the Southern States. If we take an acre of corn we can raise it without hoeing, and we can raise three tons of dry matter per acre, or about twelve tons of matter fed from the silo, and that ensilage should contain a large amount of corn. The way to raise corn is to raise *corn* and not stalks. The primary object of every farmer when he plants corn should be to raise the greatest number of bushels per acre. Then as to clover, — I see no indications of any clover fields in this country. We got over three tons per acre this year of clover hay. That furnishes not only about a ton and a half of dry matter per acre, but furnishes from twelve to eighteen dollars' worth of plant food in the roots, per acre, if we compute it according to commercial values. I throw out these ideas, hoping that they will awaken thought. This trying to get along with cotton-seed meal and oats and gluten meal, while we have left the land entirely unused as it should be used, and have not made the best use that we could have made of it, is very bad policy. After having grown this corn, a large amount of it, — for it is the greatest feeding plant the Lord ever made, where it can be raised, — and after having raised clover, the question arises whether you can afford to feed more than you can raise of any kind of grain. I would like to ask Professor Cheesman that question.

Professor CHEESMAN. I think we can. My own practice has been to use the least possible amount of corn meal, not having had ensilage to draw upon, — not more than ten or fifteen per cent of corn meal. I am inclined to think, from subsequent experience, that, where you have crops of grain such as were indicated in the paper, you can very well dispense with corn meal altogether and substitute middlings. We have got to feed some grain if we want a large milk production. I do not see for my part how by the growing of large crops of clover — that is, large crops for us here in Massachusetts — we can avoid the necessity of purchasing supplementary grain foods. I would like to remind Professor Roberts that he is not in New York.

Professor ROBERTS. I am in a better country, among a better, higher class of people.

Professor CHEESMAN. Thank you. If Professor Roberts would take a trip up the Connecticut valley over the river road he would pass not a few fields which a good deal resemble those which he knows in his own State; but we all know that on the average here in New England we have very little land that it pays to work, and when we have a clear acre, free from stone, we work it for all we can get out of it.

Secretary SESSIONS. It seems to me you rather dodge the clover point in Professor Roberts' question. He asked if we could afford to use grain when we had ensilage and clover.

Professor CHEESMAN. I have had no experience with any system of farming in which clover could be maintained without resorting to artificial cattle foods. My experience teaches me that the men who grow the most clover (and I can refer to one man who grows four tons to the acre, — Mr. Charles L. Johnson, one of the best farmers in Massachusetts, who has sold from three hundred to three hundred and twenty dollars' worth of milk per month from twenty cows) use enormous quantities of cotton-seed meal and linseed meal. Whenever they want to increase production, they find that to make more milk more concentrated food is required.

Mr. C. A. MILLS (of Southborough). I feel somewhat in doubt whether it is wise or safe to follow the advice of experts, for I notice they have quite different ideas here. Professor Cheesman has referred to the excellent farm of Mr. Johnson, a farm that I pass very frequently, and a man with whose methods I have been very much pleased; and of course I approve of them because his methods accord almost entirely with my own idea of what is wise for the milk producer in a town like Southborough.

Now, gentlemen, I believe that we are suffering here in New England from land exhaustion. That is one of the questions that confronts New England, confronts Massachusetts. If these lands were highly productive they would be occupied and used. One of the prime reasons for the abandonment of these lands is because they no longer have plant food. Now, how have they become exhausted? I think largely by raising the grains. That is what the New England farmer primarily did. He raised corn and oats, wheat and barley, and sold them and thus impoverished these lands. The farms of New England have been impoverished because we have sold more from the land than we restored to it. The question then for the farmer is, How shall I restore, how shall I build up my farm? How shall I wisely do it? I believe the wise way to do it is to buy grain. I think it is the cheapest way to do it, because when you raise a crop of grain on your land you diminish the fertility of that land. When you raise a crop of anything except the leguminous plants, except the pea and the clover and the bean, and crops of that nature, and draw it off the land, you have taken something out of mother earth. When you buy grain you buy something which has a large manurial value. When a man buys a ton of bran for twenty dollars, I say it is a good investment. Why? Because he buys in that twenty dollars' worth of nutrition twelve dollars' worth of manurial value. The man who buys a ton of cotton-seed meal for twenty-eight dollars buys twenty-four dollars' worth of manurial value. The man who buys a ton of corn buys less manurial value.

Now, this Mr. Johnson is a man who has put just that thing into practice. Not a corn field have I seen on his farm; not an oat crop waving in the wind; but I have seen his intense culture of the grasses, — three magnificent crops of grass a year.

QUESTION. Does he raise clover?

Mr. MILLS. Yes, he raises clover, but he buys grain. Is not that so, Professor Cheesman?

Professor CHEESMAN. Yes; he buys tons of it every year.

Mr. MILLS. I propose to make my farm productive by holding firmly to that idea. I propose to take off a good hay crop, and I propose to buy the grain crop, feeling that somebody else can raise that crop cheaper than I can, and that every time I buy a ton of grain and feed it in my barn I am feeding mother earth in the cheapest possible way. Now, gentlemen, I believe that for the milk producer in Massachusetts the way to success is to raise his forage crops and buy his grain.

Mr. L. W. WEST (of Hadley). I would like to ask the professor what he thinks about raising oats in Massachusetts. I do not want to take any risks in that direction. I can raise potatoes at the rate of from two to four hundred bushels an acre, and corn from sixty to a hundred bushels; but when we come to raising oats we can barely get forty bushels, and to try to raise peas in my locality it seems to me would be almost hopeless.

Professor CHEESMAN. Before I answer that question, let me put myself right with the meeting. I did not start out by recommending that we should all grow grain. That was not the central idea of the paper. The central idea was the same idea that Professor Roberts has, — grass; and the next two prominent features, cotton-seed meal and linseed meal. Now, then, what comes next? Some of us can grow grain crops, others cannot; and I am not here to recommend them to try it. I laid down this general qualification in the paper, that each one of us should decide for himself; and that is why I started out at this State Board meeting by presenting the question from the stand-point of general principles, to make it suggestive rather than to lay down a general rule for everybody to follow, because in Massachusetts it is exceedingly difficult to grow grain crops. I will say this, that, where one can grow corn and potatoes, it is best to seed down with oats; and, if we raise roots and feed middlings and corn meal and other meal stuffs only moderately, if we do not want to continue to buy meal, it is an advantage to grow grain crops. If the gentleman in New Hampshire whose figures I have quoted, without using very much artificial fertilizers, and the man in Maine whose figures I have quoted, using no cotton-seed or linseed meal at all, can grow in their rotation a crop of oats at a net cost of twenty-one cents and a fraction a bushel, we ought, in the Connecticut valley and some other favorable spots in the State, to be able to grow the oat crop, and, with abundant clover crops, dispense with the feeding of cotton-seed and linseed meal.

With reference to the case of Mr. Johnson, I presented his experience as that of the most remarkable grower of hay that we have in the State of Massachusetts.

The question which Professor Roberts has raised is, would I grow more grain? That depends on how many cattle I can keep on my farm, for we do not want to buy any more grain than is necessary for the number of cattle that the farm will support. But in Massachusetts, certainly anywhere within thirty miles of the city of Boston, it has been found that, by increasing the number of cattle and making up the deficiencies of the farm by the purchase of cotton-seed meal and linseed meal, a profitable result has been secured.

Mr. C. D. SAGE (of New Braintree). I would like to ask the relative feeding value of gluten meal and cotton-seed meal.

Professor CHEESMAN. I cannot give you the exact figures, but I should say, roughly, that I should be willing at all times to pay five or six dollars a ton more for cotton-seed meal than for the Chicago gluten meal, which is the best in the market, and at least four or five dollars a ton more for new-process linseed meal than for gluten meal, on account of the higher manurial value of those two products, as compared with gluten meal.

QUESTION. Are there not some injurious effects from the use of cotton-seed meal?

Professor CHEESMAN. If fed without judgment, there may be. I should never recommend the use of more than twenty per cent of it in making a mixed grain ration. I think that the limit of safety in all mixtures of grain is about twenty per cent of cotton-seed meal or linseed meal.

Mr. E. B. LYNDE (of West Brookfield). Something has been said about the raising of forage crops, and not feeding any cotton-seed meal, linseed meal, etc. That is what I have practised for a number of years. I have followed the course he recommends, with the exception of the use of ensilage. I have no silo. I am very favorable to the use of ensilage on many farms, but I do not think it is economical on every farm in Massachusetts. I believe that the farmers of Massachusetts generally should raise a corn crop. Corn has been grown on my farm, perhaps thirteen hundred bushels of ears, this year. I want to say that a farmer, in my opinion, can raise his corn for very much less than what he can purchase it for. We must remember that the corn crop is an excellent crop to prepare the land for grass. I do not know but that is the principal reason why I raise so much of it. I have not been in the habit of raising oats, and perhaps my experience corresponds with that of the gentleman (Mr. West) who has told us his experience. I can grow enormous crops of corn and grass, but if I sow oats they fall down to the ground.

Now, about clover. Professor Roberts speaks about raising four tons of clover to the acre. Most of us who are fifty or sixty years of age remember when we could raise enormous crops of clover on our land, cutting it about the 20th of June, but now there is very little clover grown in Massachusetts. I think that with the present knowledge of the farmer it cannot be grown successfully. I have prepared my land in the same way that I formerly did, sowed the seed in the same way, fertilized it in the same way, and I have failed to get a crop of clover where I can get from two to three tons of herds grass. Now, I would like to have Professor Roberts tell us the reason why we cannot grow clover as we formerly did. I do not agree with the gentleman from Southborough, who has spoken about the loss of fertility on all the farms of Massachusetts, for I know of one farm where the fertility has increased, and it produced larger crops this year than it did ten years ago. I think I have adopted a very good system of farming, and it has increased the fertility of the soil, and yet I have failed to grow a crop of clover as formerly.

I want to emphasize what Professor Cheesman has said relative to the growth of forage crops and the feeding of cotton-seed meal. I would feed largely cotton-seed meal, particularly because of its manurial value.

Mr. Sage. Few of our farmers have a silo, and for various reasons I have none; but I raise a large amount of fodder corn, and I should like to know if Professor Cheesman or any one can give us the relative feeding value of ensilage and fodder corn. We all know that we can raise a large amount of fodder corn to the acre, and I find that there is nothing that I can grow more cheaply, and there is nothing that the stock will relish better, than nice, well-cured fodder corn.

Question. At what stage do you cut it?

Mr. Sage. I like to have it mature as well as I can. I sow usually the white Western corn, not the large ensilage corn, but something like the Kansas corn, if I can get it;

something that will ripen early. Where I grow it for fodder I sow it closer together than I would plant, perhaps, for ensilage. I do not want it too coarse; and yet, at the same time, where the ground is rich enough, it will mature nubbins, and this year it ripened.

Question. How much seed do you sow to the acre?

Mr. Sage. I think not far from one bushel. That would be considered a large seeding, but where the ground is rich it will grow finely. I had one piece that would average ten or twelve feet high.

Question. Why would you rather have a small stalk than a large one? Do you think there is more nutriment in it?

Mr. Sage. I do not. I plant it thick because the stock will eat it much better where it is cured and fed without cutting. I never see any butts left in the manger. Of course I understand that where corn fodder is to be put into the silo or cut up and steamed, as it is sometimes, it is better to grow it coarser; but for feeding dry, in the place of hay, I want to grow it thick enough so that the cattle will eat it all. This year we had a very severe storm that beat down our corn fodder, and while there was no waste we had to expend a great deal more time and labor in setting it up. I have grown it a great many years, and think I have learned something about growing and cutting it up. I can do it with half the labor that I used to expend upon it. I used to think that I had got to bind it before setting it up, but now I just cut it and leave it several days, if it is good weather, which gives it a chance to cure, and then I can set it up in large stooks. They are standing in the field now, as we had no room in the barn. It saves a great deal of labor in handling it, and it is as bright and nice as it was when first set up, and will be until spring.

Professor Cheesman. I have had no experience in the growing of corn fodder. My practice has been always to put my corn crop into the silo. I believe that a majority of farmers who have practised both systems have decided that siloing corn is the cheapest possible way of disposing of the crop. But, whether you have ensilage or not, I say grow corn and grow it as Professor Roberts would, not as this gentleman would. Ten or twelve quarts to the acre is plenty, planting the kernels at a distance of thirty-six or thirty-nine inches apart. Grow corn for grain, whether you ensilage it or not.

Question. You put the corn ears and all into the silo, as I understand it?

Professor Cheesman. Yes, sir.

Question. Do you raise clover?

Professor Cheesman. We have no difficulty in Southborough in raising clover.

Mr. Lynde. It is the almost universal practice, I believe, among the farmers of Massachusetts when they seed down their land to sow timothy, red top and clover, say eight or ten pounds of clover seed in the spring of the year. Sometimes we sow it with barley, sometimes with oats, sometimes we sow it on the snow early in the spring; but, whatever way we sow it, we get very little clover. Formerly this clover came up the first year, and the next year we would have a great crop. We would cut it about the 20th of June, and we would often get another very large crop. For some reason unknown to me, we cannot do so now. Will Professor Roberts tell us what is the trouble with the land that we do not get as good crops of clover as formerly on land which I think is equally as strong and equally as good? I want to know whether the land is clover-sick, whether the climate has changed, or what is the reason?

Professor Roberts. The reason why clover does not catch so well as it used to probably is that the soil is somewhat depleted of its mineral elements. Clover does not thank you for nitrogen. I could take you to our fields to-day where we actually killed clover with nitrogen. Clover is able to get all the nitrogen it wants on ordinary soils, and it does not thank you at all for it; in fact, it abhors nitrogen if there is too much of it. We find in practice in New York that if we sow plain phosphates with our wheat and a little potash the clover will take, but if we do not sow phosphates with our wheat the clover is not apt to come in; showing conclusively that what clover wants is some mineral matter to start with. Now, you have been farming scientifically and very properly by saving your manure to keep your land rich; especially have you been buying grain which is too rich in nitrogen comparatively and too poor in mineral matter.

Mr. LYNDE. I have sowed ground bone sixteen hundred pounds to the acre and six hundred pounds to the acre, and I have sowed in connection with the ground bone muriate of potash; so I have conformed to all these conditions, but still I have failed to secure the crops of clover, year after year, that I formerly did.

Professor ROBERTS. I said that that was probably the reason. Another reason why you do not get clover as you formerly did is on account of the borer that attacks it. It bores down to the roots in the ground. With us our clover never leaves out, and we plough it up. Another reason why we cannot get clover is that the leaves are often attacked by a fungous growth. A year ago I had twelve acres on my own farm, some sixteen or twenty miles from the University, where all the conditions, so far as I know, were good for a clover crop, and I got no clover. In that district, embracing nearly a whole county, a disease attacked the leaves of the young clover and destroyed them. So that there may be various reasons, but I think the prime reason for not getting good clover crops here in Massachusetts will be found to be the want of readily assimilable mineral matter; that where the land has been kept up it has too much nitrogen in proportion to the mineral matter. You have taken that away.

There are some other things in regard to this subject, Mr. Chairman, that I would like to speak of, and one is the ease of raising grass. The question I wanted to raise was not the question of feeding concentrated food, but how are you to make good use of the land that you have manured?

Now, in regard to raising corn. (These are only hints at better methods.) First, the corn gets a large amount of its plant food from the sun. That is free carbon. That is a free gift from the gods, and never exhausts the soil. Carbonaceous matter never exhausts the soil. Carbon is not manure. The plant gets it from the sunlight. Therefore the corn, being quite largely carbonaceous, takes comparatively little out of the soil; it takes mineral matter. Now, the clover plant actually produces nitrogen. The soil that has five thousand pounds of nitrogen in it this year, if it grows a crop of clover next year and we take off two tons of clover hay, actually has more nitrogen in it than it did the year before. That we have positive proof of. We know that leguminous plants are able to bring us more nitrogen through the office of the animal organisms which live upon the roots of the plants. Now, it seems to me that the work of the farmer is somehow to catch his sunbeam and get the carbonaceous matter — that is, energy, that is, heat — out of it and give it to the soil, and take out the potash and phosphoric acid and give it to the soil. Then, on the other hand, take the clover and bring out the nitrogen and give it to the soil, and give it to the air through the office of the microbe and the clover root.

Now, I want to go back to the point I raised, and that is this, — not to stop feeding grain where it is necessary, but to see if we cannot raise more of this great plant that we have, and learn how to raise it. We had about seventy bushels of shelled corn to the acre this year, and our corn field has never seen a hoe, and I will undertake to say that there are no weeds there that a man need to feel at all bad about. We have raised over eighty bushels to the acre. You cannot do as well here, because your climate is colder. Your soil is as good, your men are as smart and may be a little smarter, but your climate is a little colder.

Now, I ask you, — for I came here to get knowledge, — I ask you in all fairness if it is not time that we went right out into the field and discussed agriculture there, instead of drawing checks for our cattle foods? One of the farmers in our State said that the ruination of a good many farmers was that they paid out all their money for cattle food, and were not successful in getting back the profit at the other end.

I noticed another thing in the speaker's paper that struck me forcibly. He talked of putting ten dollars' worth of manure on an acre. I think that is too much manure to put on an acre economically. I would as soon think of feeding a horse two bushels of oats in the morning as of feeding a field twenty, thirty or forty loads of manure in a year, so far as economy is concerned.

Another thing I would like to ask the speaker. Did I understand you correctly as saying that the dried matter of corn was equal only in digestibility to the dry matter of ensilage? I had supposed that the dry matter in corn stalks was not worth nearly so much as the dry matter in dry corn, because, when I ask the cow about it, she says, "I will take the corn every time."

Professor CHEESMAN. I said that, while the amount of dry matter in corn meal was not all digestible, I was willing to consider the amount of dry matter found in corn meal as equal to that found in ensilage in digestibility, and give the corn meal the benefit.

Secretary SESSIONS. Those of you who have perused the bulletins from the Hatch Experiment Station will remember that Professor Brooks found in his practice that clover followed the application of potash; that wherever potash was used there clover came. On the plot right opposite to it, where no potash was used, there was no clover. The clover remains for several years where the potash was used. These were experimental plots, but the same thing holds good, I believe, on the farm.

Mr. LYNDE. I would like to have Professor Roberts tell us just what his soil is. Is it entirely free from grass and entirely free from stones or rocks, and, if not, how great a part of it has stones or rocks or gravel upon it?

Professor ROBERTS. Allow me to preface the answer by saying that I have made a long study of the corn crop, seeing that it was the great American plant above all others, and I have had a very wide experience in the far-away South, having raised seventy acres of corn there this year, in Mississippi, and in the far West, in Iowa, having raised a large quantity of corn there in previous years; and, having had fifteen or twenty years' experience at Cornell University, and having made a great many experiments, I think I have learned somewhat of the law of the corn plant. I do not think I know it all, by any means. I am still pegging away at this subject, because I believe it is the plant to be raised as a forage plant far more than it has been, and I think we have not taken pains enough to study the law of raising corn.

The land upon which we grow corn is very variable. Part of our land is very stony and part of it is brick clay. Quite a large proportion of the field where we raised corn this year has been dug over for burning brick in years past. One side of the field is gravelly. In fact, if there is any kind of a soil you ever saw, we have that soil. We have level land and we have hilly land. I would never farm hilly land if I could get level land.

Now, as to corn. If you will stop a moment to think, you know that this corn plant, unlike most of the other grasses, wants heat. The timothy and the clover will start early in the spring, before the snow is off the ground; in fact, they grow all the time unless the ground is frozen very hard, whereas corn wants the heat of the sun, — frost kills it. I fear we do not think of this when we plough the ground, when we feed the ground and when we manure the ground. Before we plough we manure the ground with about five loads per acre, spread on the surface by hand. A load is about a ton and a half as it comes from the stable, of mixed manure, cows and horses. That is about all we can afford to put on, because we have got one hundred and fifty acres, and it all wants a little something; it all wants a little nibble, anyhow, if it cannot get any more. I do not believe in overfeeding one plant and letting the others starve. About January or February we shall have the corn field covered with manure. The balance of the manure that we cannot put on the field at that time or in the pastures we keep in a covered yard, so as to preserve it. We have no barnyard, have not had for fifteen years. We never turn an animal out of doors unless it is for exercise. If there are any large stones rolling round on the surface, we take them out. We have got most of the large ones taken out, and the ground is in good condition. After spreading the manure we take a marker and mark out the rows three by six, and then we have a Western two-horse corn planter that will plant from eight to twelve acres a day, — plant, cover and roll, — and we plant one way. This corn planter makes the rows very straight and the corners in line; the other way the boy often makes them a little crooked. The object in check-rowing it is because, although we cannot raise quite as much corn as we can in the drill, if the hot weather comes the grass catches me, and the weeds, and then I have got to put in the hoe, and the most expensive kind of farming is to farm with human muscle. I want to avoid that, and so I check-row my corn so that my workmen may go in both ways. I begin with a two-horse cultivator, and weed this field before the corn comes up, four days after it is planted, or six days, or ten days, according to the season, whether it is cold weather, or whether it is warm. We plant a Western corn, which comes up quicker than our native corn. I do not pack that ground down as I would if it were a field of wheat, because winter wheat wants a good hard foundation, with a little soil on it, but a hill of corn wants heat; so I leave my soil just as loose as I can at this time, and then after it is planted I take a two-horse corn cultivator, and I know exactly where the corn is, because this little roll tells me where it is that the corn planter left it through the field, and I cultivate it back and leave it corrugated and rough, because that lets the ground get warm and dry out. That makes the weeds get out of the way, and this one cultivating does more than any other cultivating that I do. I harrow the ground after a little, or I may turn round immediately and harrow it, and as quick as the corn is up to a satisfactory height I replough the straight way, — the way I planted it. I cultivate it then, using a one-horse cultivator with very small teeth, not much larger than harrow teeth, because when the man drives through the field I want him to cultivate the corn and not the middle of the row. There is nothing there, and I do not care anything about it; I can attend to that later. I want him to go so close to the corn as to make every hill tremble. That is the time when a day or an hour in the field is worth a great deal. Then I cultivate it from time to time, using sometimes one horse and sometimes two, according to the lay of the land and the character of the soil. I go through that corn field about five times, and if it is properly done, with proper implements, it has good clean culture, and if there is a weed here and there I am not very particular about it, unless there are two weeds, and then I pull them out. Sometimes I pull out Canada thistles. There are apt to be a few Canada thistles in our field.

QUESTION. How late do you cultivate the corn?

Professor ROBERTS. I cultivate until the tassels come out. Now, my friends, I would advise you in all kindness to plant a good deal of timothy. What I said about feeding a horse a bushel of oats in the morning applies to putting a large quantity of manure upon land. I saw a piece of land not long ago that had had forty loads of manure to the acre dumped upon it, and I went to work and figured up the nitrogen at sixteen cents a pound, the potash at fourteen and a half cents, and the phosphoric acid at seven cents, and I found that the man had put on between twenty and thirty dollars' worth of plant food. Can you afford it?

QUESTION. How many stalks do you leave in a hill?

Professor ROBERTS. Three to four stalks of the Dent corn called "Pride of the North." It has become acclimated with us now, and gets ripe as quickly as the New York or Canada hard corn.

Now, my friends, I should just as soon think of planting peach trees two feet apart each way, and expect to get the highest results (I can get some results), as of planting two bushels or one bushel of corn per acre. Corn is a sun plant; it wants sun all around it in order to develop the valuable carbo-hydrates.

Now, I want to speak about soil exhaustion. My friends, your soil is not exhausted. You cannot exhaust the soil; the Lord took good care about that. You may deplete it so far that profitable culture under the high-priced system of labor we have now ceases, I grant you. Now, I have taken some land at Cornell University that was supposed to be very poor, worn out, as it was termed, and had been given up, and I have been raising on it the last four years an average per year of twenty-five bushels of winter wheat per acre without any rest, without any phosphates or any manure. I tell you this not to brag, but to emphasize the importance of thorough culture. I say I tell you these things not to brag, because, if there is anybody in the world who cannot afford to brag, it is a professor. He must tell facts and be able to prove them, or he is not worth much. That is the way I feel. I hate any unsupported statements. Now, I believe you are in the same boat that I was in a few years ago. I became possessed of a farm about thirty miles from Cornell. One field, a back field, was poor land, and had been substantially abandoned. When they got through with all their other fields they went up there and did a little work. The meanest kind of grass got in there, and Canada thistles and mullen. My man said, "What am I to do with that old back field? The field down by the road is good land, I sold it once for fifty dollars an acre; but what shall I do with that back field?" Said I, "Plough it five times." "Do you know," he says, "that for twenty-five years no man has taken out a load of anything from that field but at a loss?" "I know," I said; "but they did not know how to farm." That was pretty strong language, because that was right where I was born. To make a long story short, he did as I told him. He did plough it three times, some of it four times, and put about twenty dollars' worth of phosphates on twelve and one-half acres. As far as I could see we had done our part, and then we prayed for a crop. I sold the wheat off of that twelve and one-half acres for a dollar a bushel. I was very proud of that, because I was the only man who got that price for wheat that year. Then I got about sixteen dollars a ton for the straw, thirty miles from that farm, and when I got that whole thing all cleaned up I had two hundred dollars for my share, and out of that I had to take my phosphates. That was more clean money than they had got off the hundred acres of land for the last five years per year. I say that that was simply taking advantage of a law to which too little attention is paid, and that is, that if we would get plant food out of the soil we must grind the soil. That is the way the Lord made rocks into soil, and you have got to do the same thing with the land which you have. I went out to that field and found that the clover had not caught, and of all things in the world it was clover I wanted, because I could not go on in that way; it was too expensive to buy commercial fertilizers at forty dollars a ton, any large amount of them, and go on and raise wheat at eighty or ninety cents a bushel. That would not do; I must bring the clover in to aid. There was no clover there. So I said to the man, "You must replough this field; there is no other way, and you must plough it right away quick. Before you do anything else on this farm, get the teams out and turn this land over:" and then about every three days I wrote down to him to hustle round and harrow that clover field. So he went to work and harrowed that field thoroughly. Then again fertilizers were put on amounting to twenty dollars, and now the wheat is in the storehouse. I have the number of bushels, but I have not the money in the bank. I have bargained it for seventy cents a bushel, but again I sold the straw for $16.30 a ton. I shall get about one hundred and fifty dollars from that field for my share.

I am telling you this because I have come to your State to try to benefit you, and as I came along it struck me that you have not laid stress enough on culture, or getting out of the soil all that is in it. If you leave it there and do not get it out, it might just as well never have been there. You want to get it into a crop, then into an animal, and then back again to the soil. First the plant, then the animal, and then the fertility to feed another plant, to feed another animal, to feed another plant; and so it goes on. As the three little golden links go round, — plant, animal, fertility, — man reaches in and tolls. And when this man says "Plant clover," he is right, because that does not carry off any of the farm.

QUESTION. Did the clover seed this time?

Professor ROBERTS. Yes; I got a good clover crop.

Mr. WM. BANCROFT (of Chesterfield). I think this discussion is interesting, but in all candor I want to ask if there is any farmer here who has undertaken to raise corn with five loads of manure to the acre? The gentleman says he cultivated his corn ten days before it was up. Now, out in the western part of the State, where I live, if my corn was not up in ten days it would never come up; it would be rotten.

Professor ROBERTS. The gentleman misunderstood me. I said four, six or ten days. We frequently plant corn in April in New York. I am not afraid to plant it early. I am not afraid to have the ground freeze a little after I plant corn, if the ground is properly prepared.

Mr. W. M. McINTOSH (of Nantucket). I want to get a little more information from the professor. I live in Nantucket. It is an island in the sea, and the soil is generally what is called sandy loam, and sometimes clover grows there first rate; but I have found that sometimes for two or three years I would not get a good crop. I did not sow ten pounds to the acre, — I never did. On my land I have considered four pounds of clover, half a peck of timothy and a peck of red top abundant seeding. There will be two or three years in succession when clover will be an entire failure. Perhaps it will be there in the summer, and in the spring it will not be there. I thought it was possible that it might be owing to the poor quality of the seed, and I am working on that idea now, and get my seed from the place where I got it when I was successful. But I have not put on dressing for the grass crop. My business is the raising of vegetables and hay. I have a rotation by which I cultivate about three years and then sow down, and keep going round and round, and put in the manure for the vegetable crops. But one thing I have noticed, and that is, that on the best of my land I am most successful with clover. I wish I could get a crop with the small amount of manure that the professor has mentioned. We reckon loads perhaps in a different way. A load with us is twenty-eight cubic feet, without being trod. I have seen very few farms where they have put on from thirty to forty such loads of barn manure to the acre.

Professor ROBERTS. Do you know anything about the value of those loads by analysis, — whether twenty-five dollars or five dollars?

Mr. MCINTOSH. No; but it is such manure as we use all through the eastern section of Massachusetts, — largely horse manure. It is where considerable bedding is used. I want to get at this clover question, because when clover succeeds with me I get the best crop I can get of anything. My land is adapted to red top and clover rather than to timothy.

Mr. J. H. HALE (of South Glastonbury, Conn.). My line of farming is not exactly that which has been under discussion here this morning. I know very little about cattle foods. I use in my farming operations a large amount of fine-ground bone and potash in various forms, and on lands fertilized in this way I have never had any trouble in growing clover, which I plough under in the spring.

Secretary SESSIONS. Will you describe your soil?

Mr. HALE. The most of the soil on our farm is a sandy loam, rather light, some yellow loam, and rather a granite, stony soil at the further end of it. We manure heavily with phosphates and potash, depending very largely upon clover for our nitrogen.

I have not heard anything said about the time of sowing clover. I get an abundance of nitrogen for my business, fruit culture, from clover. I understand from Professor Roberts that it is sown in his section about the first of April. I have sown clover almost every month in the year, but on my farm in Connecticut I find that July, of all the months in the year, is the best. By sowing clover at that time in our orchards, in some of our berry fields, or in our corn fields, we get a good stand of clover; it makes a fine growth before fall, in the winter it is in perfect condition, and the next May we have a field of clover there that makes us all laugh and makes the land laugh. We sometimes sow it as late as the latter part of August, and we have never had trouble, but usually the middle or last part of July seems to be the best time. We harrow it in with a cultivator. Sometimes if it is a rainy time we do nothing with it, but let the rain carry the seed into the ground.

I have had no experience in Connecticut in raising corn, but several years ago I bought what was considered a worn-out farm in Georgia, and on one portion of that farm there was a cotton field of eighty acres which the people about town used to laugh at me occasionally for buying. "Well, Mr. Hale," they would say, "you bought a very fine plantation over there, but you got rather stuck on that old cotton field." Well, we ploughed that field this last February, and in March planted it with corn in check-rows four feet each way. We ploughed it reasonably deep with a wheel plough, applying six dollars' worth of a commercial fertilizer per acre, and planted it with corn. We did not cultivate it before it came up, as the professor did, because it came up very quickly; but after it had got to be two or three inches high we started with a couple of Thomas smoothing harrows to harrow it. The colored individual who drove the mules when set to work by the superintendent to harrow it over said, "Massa George, does Mr. Hale know you are going to do this?" He said, "Yes, he understands it." "I dunno," says the darkey, "I never see nothing like that in this yere place before." A neighboring planter came along and called out across the field, "Hullo, you old nigger, what are you doing?" Says he, "Massa George done told me to do this." He says, "He told you to do something else, and your stupid head don't know what he wants." He drove up to the house and told the superintendent the trouble that that cotton field was getting into with that stupid nigger. "Oh," says he, "that is all right; that is the way we grow corn in Yankee land." So the field was harrowed all over, and in ten days it was all harrowed over again. It had three harrowings with a Thomas harrow. The last harrowing did break off some of the corn, and perhaps did some little injury. Afterwards the cultivator was put into the field, but there was never a hoe put into it. We harvested from that eighty-acre field in central Georgia about forty-five bushels of shelled corn to the acre. I attribute the result to most thorough and everlasting culture.

Mr. West. The professors have said but little about potash. From my own experience I have found that much of the soil where I live is deficient in potash, and by the application of one hundred and sixty pounds of muriate of potash to the acre I have increased my corn from thirty to forty bushels per acre. As Professor Roberts has said nothing about the application of potash, I think perhaps his soil has plenty of it. He can plough up a brickyard or almost anything else, and by cultivation can raise a splendid crop of corn. I have my doubts about that being done in Massachusetts, where our soil is deficient in potash.

Professor Roberts. I think possibly I may have led the audience astray. I came to Cornell University a number of years ago, and found what was termed an old, worn-out farm, and it has been a great study with me to bring it up and make it fertile, productive and profitable, — for that is the point we all want to get to finally. I soon learned that with our environment I could not afford to haul manure if it was given to me. We are four hundred and fifty feet above the village or city, and as fast as I hauled manure the weeds grew, some of them, very fast. So I went to work and built sheds over my yards, keeping my cattle in, buying a little food at first, and went into the dairy business. I found I had not manure enough on the farm, could not make enough to go round; and the question arose, shall I put thirty or forty loads, as I see my neighbors do, on a little piece of ground, and then in the fall of the year go down into the town or to the four corners and brag what a tremendous crop I raised, when the daisy occupied three-quarters of the soil in the back field when I started, or shall I try to bring all this farm up and make every acre of it valuable? Some of it I seeded down and put into permanent pastures, and I fed those pastures nearly every year with just a little bit, and men come a good ways to see those pastures on my hillsides, carrying, some of them, an animal to the acre, with a little feed for it in the stable. Now I go over nearly all my farm every year, or a good share of it, and keep it up. That is the way I have secured success. There is not an acre on the place, except a few that are kept for ornamental purposes, that is unproductive, and there are places where I can make a little money even at the present prices.

Professor CHEESMAN. How large a farm is it, and what is the distance from the barn to the farthest field to which you cart your manure?

Professor ROBERTS. The total area of the farm is two hundred and sixty acres. There are about one hundred and sixty acres all told of arable land. Our manure has to be hauled less than half a mile, the buildings fortunately being situated nearly in the centre of the farm.

Professor CHEESMAN. When you go over that farm to keep it up, what do you do? Don't you put something on it when you take something off? You must do something. Five or six loads of manure per acre would not do much towards keeping that farm up.

Professor ROBERTS. If I had five or six hundred loads of manure, that would be about five cords to the acre. I want from four to five loads on the wheat ground; I do not care about five loads on the pastures every year.

Professor CHEESMAN. What do you put on your pastures?

Professor ROBERTS. As far as I can I try to imitate the Lord's method of building soil. I spread the fertilizers on the soil in the fall where there is a plant growing. That is the way the soil was built, and I am going to imitate that as closely as I can. I put the manure on the surface in the fall thinly where there is a plant growing, to act as a little blanket as well as a fertilizer. I don't want you to feel that I came here to preach, — I came here to learn.

Professor CHEESMAN. Before you sit down, won't you tell us your rotation and your general system of management of crops?

Professor ROBERTS. One year clover, one year corn, one year spring grain, — oats, barley and flax, — roots of various kinds all go in there, — and one year wheat. It is a four-years rotation. The reason I do not make it five, and grow clover two years, is that the beetle destroys our clover after one year, — eats it up.

Mr. LYNDE. The rotation that Professor Roberts has given us is the rotation that is usually followed, as I understand it, in the State of New York by the best farmers. I do not think that the farmers of Massachusetts would be successful with that rotation. Different localities of course require different methods.

Now, in regard to the use of barn-yard manure. For a period of years I have applied chemical fertilizers on very strong land, believing for the first few years that I had found the philosopher's stone; but on that same land, after the use of commercial fertilizers for a series of years, I have found that I did not succeed as well as I did at the commencement, but by the application of barn-yard manure I was all right. That is, there was the mechanical lightening up of the soil that was necessary. The soil was hard when I used nothing but chemical fertilizers.

One thing more which I think is of importance to the farmers of Massachusetts, if we can only get at it. The gentleman from Nantucket said he had not succeeded quite as well with his clover as formerly, and asked a question about seed. I do not know as to that, but I feel that the farmers of Massachusetts are sowing with the seed that they purchase a good many weeds. Down in Hingham and about there the land is covered with wild carrot, so that in the blossoming season it appears to be as white as it is about here with snow this morning, and that wild carrot has got into a good many farms. There is a firm in Binghampton who are sending out circulars to farmers in which they claim that their grass seed is free from weed seed. If we can only get grass seed that is pure you can see how valuable it must be. Any farmer would rather pay three times the price for grass seed that he knew to be perfectly pure, thoroughly clean, than for that which he does not feel sure about. I would like to have Professor Roberts tell us whether he knows anything about it, whether it is a humbug, or whether this seed is so clean that the farmer can depend upon it.

Professor Roberts. I am well acquainted with Mr. Whitney. The firm is entirely reliable. I am constantly in correspondence with them, for I buy all my seed from them. It may be news to you, but they are trying to discover the value of this weed seed for feeding purposes.

Mr. Stoddard. The question which comes to a young farmer taking an old farm is, "What can I best grow to feed my cattle?" "How shall I best feed my cattle?" is a question that every farmer must decide for himself. Some of the speakers have advocated purchasing most of our cattle foods, others home-grown foods. I have always advocated home-grown foods. Having had some experience in the West and also here, I believe thoroughly in corn as food for animals. I believe in growing corn on every farm. I can hardly agree with some of the theories put forward by our good friend Professor Roberts; they are hardly borne out by my experience. I should not advise any young man to plough up the larger part of an old farm, and be to the expense of cultivating that large farm for a few bushels of corn. It seems to me he had better plant fewer acres, put on less labor, and get more returns.

Professor Roberts. Will the gentleman allow me to correct him? I said that I spread the manure over the farm, not that I ploughed it all up.

Mr. Stoddard. I alluded to the amount of manure put on the land. I felt that he was going over a great deal of land for the amount of manure. You must feed your soil if you want a good crop, just as you must feed your cow if you want her to produce milk.

It seems to me that in growing corn we should plough our ground to a pretty good depth, so that the heat of the sun will go down deep, and if there should be a dry spell when the soil has been stirred only some four or five inches down, the roots of the plant do not get down deep. Plough your ground twice and harrow it four or five times before planting. A crop well cultivated is half grown. Manure the ground when it is planted and harrow it with a wheel harrow or any other, but do it thoroughly. Do not be in too much of a hurry to plant the seed, but when the land is ready then harrow it and immediately plant it. Do not plant your ground before a rain, but harrow it after a rain and plant it after that, so that the seed will have a good chance to start, and the seed will usually come up quickly when planted in that way.

I am now speaking of raising corn without hoeing, which has been my custom. You know out West it is the rule that one man can take care of forty acres of corn. A boy sixteen years old can do it, and so can a man, and he cannot do any more. It is the custom in the West, in raising corn, as perhaps most of you know, to plant the corn, as Professor Roberts has stated, with a two-horse planter, planting two rows at a time, and many have got into the practice of harrowing that corn ; but at the time I lived there, some fifteen years ago, it was the practice to let the field remain until the corn got up some four inches, which is very soon, for corn grows much faster there than it does here. The next time they will go through the field with the harrow the other way. It is the rule at the West to go over a corn field once a week, and to stop cultivating it about the first of July, so that the man who has taken care of his forty acres of corn and has other work on hand can go about that. But I feel that here in New England we can compete with the West and South in raising corn.

In regard to corn fodder, which has been so ably spoken of here to-day, I believe in it most thoroughly. That is the way we can compete with the West. I believe in most thoroughly manuring the ground and most thoroughly cultivating it before planting. I would use phosphates if I did not have manure and plenty of it. I would manure the ground well, cultivate it well, and take good care of it all through. I do not believe in going over too much ground. Our farmers are trying to cultivate too much land, laying out too much labor. A man should only plant what he can take care of well and manure well. I believe that is the secret of success to every young farmer.

Mr. J. H. Dyer (of Marlborough). I would like to ask the lecturer in regard to the matter of feeding oats and peas, as was recommended to us a year ago by Ex-Governor Hoard of Wisconsin. That is to say, how shall we feed them, and in what quantities shall we feed them, so as to get their best feeding value?

Professor Cheesman. That is rather a large question. I must fall back upon the general propositions laid down in the paper. If the land on the farm is available for growing oats, and is not absorbed by other crops, it is certainly advisable to grow that one, and use the mixture in such proportion as you find convenient. That is to say, if you have enough of it, you can feed from four to five pounds a day in combination with other mixtures of grain; if you have a small quantity, you would naturally use a smaller proportion. It depends to some extent upon what other feeding materials are at your command. On general principles, I always recommend the use of oats as feeding material in some form; and under existing conditions I see no way of obtaining oat feed in any form whatever unless we grow it on the farm.

Mr. Dyer. I see that the gentleman had the idea of feeding the grain itself. Now, it would be impossible, almost, here in Massachusetts to grow this crop so that we could harvest the grain and make use of it as a cattle food. We must grow it and dry it or ensilage it. Governor Hoard gave us the idea that we might supplement our bran and other nitrogenous foods by raising oats and peas. I have a silo filled with ensilage corn, the best I knew how to raise.

The question with me is, how I can supplement this ensilage corn with oats and peas so as to make a balanced ration.

The Chairman. I see that Dr. Goessmann is here. We are always glad to hear from him.

Dr. Goessmann. We have raised during the past season several mixed fodder crops for green fodder and for hay; one acre of Canada peas and oats and one acre of summer vetch and oats. We used, sowing broadcast, two bushels of Canada peas and three bushels of oats per acre, and obtained six tons of green fodder per acre, of a feeding value equal to clover hay. The Canada pea grows rank, and lodges to a considerable degree in spite of the oats, and for this reason I prefer the summer vetch and oats. The vetch is a slender plant, and more apt to be held up by the oats. From forty to fifty pounds of vetch, with four bushels of oats per acre, seeded broadcast, has given us eight tons of green fodder per acre, of an equal if not superior food value to the Canada peas and oats. Both mixtures of crops may be fed green or as hay, or may be made into ensilage.

The introduction of annual leguminous plants, like peas, vetch, Scotch tares, soja bean, etc., on a more extensive scale, is in my opinion a step in the right direction to cheapen the production of milk and meat by increasing the production of home-raised cheap and valuable coarse fodder articles.

Mr. F. W. Sargent (of Amesbury). I am very much pleased to have this subject of oat and pea fodder brought up, because I am deeply interested in it; in fact, it forms a very important ration for my cows during the season. I have grown an oat and pea crop for ten years, and have found it remunerative. At the present time I am feeding my cows in the afternoon of each day on this cured fodder of peas and oats. I can hardly see the necessity of putting it into the silo to cure it, and I should doubt whether it was advisable. I am a friend of the silo, although I have none. I can cure oats after they get to the stage in which I wish to cure them, very cheaply, that is, with the usual good hay weather along about the first week in July; and I am satisfied that, if the farmers of Massachusetts will grow more oat and pea fodder for their cows, it will be a money-making operation.

Secretary SESSIONS. It seems to me that the point that was raised has not been touched upon; that is, the proportion of ensilaged oats and peas that can be most profitably fed with corn ensilage.

Mr. DYER. I will put the question in another form, and then perhaps you will get at it. We have been told that, if we feed sixty pounds of ensilage and four quarts of shorts, we are feeding a balanced ration to a stock animal to keep that animal in condition. What I want to know is, how much shall I reduce my sixty pounds of ensilage, and how much of this ensilage of oats and peas shall I put in so that I need not use my four quarts of shorts?

Professor CHEESMAN. I did not understand that Mr. Dyer was asking in relation to the use of ensilaged peas and oats when he put the question. Let me say here, in the first place, that I do not approve of any such ration as four quarts of shorts and sixty pounds of ensilage. I think the best practice now-a-days, certainly in the Eastern States, is to limit the consumption of ensilage to a quantity not exceeding thirty pounds. If we feed beyond that amount, we are very apt to find the animals shedding their coats too early in the spring, and that such practice keeps them in a relaxed condition. I should prefer to increase the quantity of hay, preferably clover, to cut down the ensilage from thirty or twenty-five pounds, or whatever forms the limit, and use a quantity of ensilage made from peas and oats sufficient to bring up the total quantity to thirty pounds. The quantity used would depend upon the amount harvested and on the number of cattle kept. That is a question nobody could answer but the grower of the ensilage.

The CHAIRMAN. I see Mr. Kilbourn here, and we should be glad to hear from him on this subject, as he is thoroughly well posted upon it.

Mr. W. A. KILBOURN (of South Lancaster). I am not prepared to give any information on these points. At present we are not using ensilage, simply because our silo was destroyed and we have never replaced it. I agree with the gentleman (Professor Cheesman) that sixty pounds of ensilage is too large a feed for profitable or desirable results. I should prefer half that amount, and the addition of a proportionate quantity of grain.

The Chairman. We should be very glad to hear from Mr. Gold, the secretary of the Connecticut Board of Agriculture. I am sure he can give us some points on this subject.

Secretary Gold. I have had very little experience in raising peas. As Governor Hoard recommended them so highly, we sowed a small piece last spring, which we used very satisfactorily for feeding our swine. We raised them for that purpose, and did not have any to spare to use for dairy cows; but those who have used them in Connecticut, where they have succeeded in raising them, — and they have to some extent, — as a soiling crop or as dried and fed in that shape, commend them very highly. But my memory goes back to the time when peas were much more extensively raised in this State and in the State of New York for feeding purposes, and they were very highly approved. If cut in its early period of ripening, when the first pods were nearly ripe and the stalks still green, the crop was considered the best possible winter fodder for sheep and lambs in the system of farming when sheep culture was a prominent feature. But in raising peas we want to take into account one fact that has been recently brought up, that all these leguminous plants have the faculty of gathering nitrogen from the atmosphere, and in raising them we are adding to the fertility of our farms. We must not confine ourselves merely to the direct return from this pea crop, but add to it the less perceptible but as surely inevitable result, that we are thereby adding to the fertility of our farms. Please bear that in mind in the purchase of your feeding materials, — that the manurial value is to be taken into account. Please bear in mind also that in the culture of your crops the manurial value and effect upon your farms themselves is an important element to be taken into consideration. I believe that the present drift of science will lead our farmers to adopt what I believe to be a better system, in which the legumes will form a more important article of our cattle foods.

The Chairman. We should be very glad to hear from Mr. Fenn, of the Connecticut Board of Agriculture, if he will favor us.

Mr. Fenn (of Milford, Conn.). I have had no experience in raising any of these leguminous plants other than clover for cattle feeding. I have never raised peas or beans for that purpose. My business of late years has largely been seed growing, and as a consequence my attention has been more directed to that than to the study of these other things. I have raised clover, and latterly more than I did when I began, and I think I have seen the beneficial effects of it in the increased fertility of the farm.

Mr. B. P. WARE (of Marblehead). I would like to ask Mr. Sargent whether he has found, in his ten years' experience in growing oats and peas, that they are liable to lodge, and, if so, how often? And also how many seasons his oat crop has been attacked by a fungous growth which caused a blight, if ever?

Mr. SARGENT. I do not think that I have ever seen any blight in the oat crop on my farm. I have grown this crop, as I said, for ten years. My plan has been to plant peas just as early in the spring as possible, harrowing in the seed with a wheel harrow. That is one great point,— to get the peas into the ground early, and get them in deep. If they are put in to a good depth, I think there is very little fear of any blight on the peas.

QUESTION. What depth?

Mr. SARGENT. Well, as deep as I can get them in with a wheel harrow, — perhaps three inches. I should just as lief put them in four or five inches, but I do not like to plough them in.

Secretary SESSIONS. Do you cover the oats and peas together?

Mr. SARGENT. Yes, sir; I sow the seed separate, but I cover them together.

Secretary SESSIONS. How much seed do you sow?

Mr. SARGENT. I sow two and a half bushels of oats and from one and a half to two bushels of peas to the acre.

QUESTION. What kind of soil have you?

Mr. SARGENT. I am like some other gentlemen here. My farm contains three or four different kinds of soil, perhaps more than that. It is hard-pan underneath, and some pretty good loam from five to eight inches in depth. I buy my seed of a seed dealer in Boston. I buy the Canada peas, and get as clean seed as I can.

Professor Cheesman. Have you always used as heavy seeding?

Mr. Sargent. Yes; I think I have never used less than a bushel of peas to the acre. My object in sowing all these crops is to get a soiling crop for my cattle; and I commence cutting just as quick as I can cut a good swath, and feed this until I think it is getting too hard to be used in that way, or something else comes in.

In answer to the first question asked by the gentleman, I will say that oat and pea crops are very liable to lodge, and invariably lodge towards the east. So I sometimes find it necessary to cut them from the east towards the west. In that way the machine will cut them very clean, and I have very little trouble from the stubble that is left on the ground.

Mr. Ware. I should judge, from the amount of seed that you sow, that the oats and peas would be very liable to lodge; and in lodging do they ever rot underneath?

Mr. Sargent. Not to any extent; they will a little. Now, I speak in regard to curing the crop dry rather than putting it into the silo. The oats are in the milk or in a soft state, and the peas have pods with small peas in them. The dried fodder which I am feeding at the present time has peas as large as buckshot in the pod. After cutting this fodder it was raked into windrows, and the third or fourth day was put into a stack out-doors. I put this fodder into a stack, because I was short of barn room. I think it is a most excellent idea to stack it before putting it into the barn, which can be done with very little expense. My experience this year is that it does not hurt in the stack. I covered the top with a canvas, and it is coming out bright and nice.

I will say just a word on the matter of corn and corn fodder. My farm being small, all the ripe corn I raise is my surplus from the soiling crop. I have planted now for two years nearly all of my fodder corn in hills with a planter, the same as I would field corn that is to be ripened and to be used as a grain. I cut up corn this year with ears twelve or fourteen inches long. The cows like it just as well as if there were no ears upon it. I think when a person sows more than one bushel of seed to the acre for fodder corn his fodder is likely to depreciate in value.

Professor Cheesman. Why do you cut it before the corn matures?

Mr. Sargent. Simply because I want the green feed for my cows. I cut it when it is large enough to use for forage.

Question. How far are the hills apart?

Mr. Sargent. Three and a half feet by three.

Question. If you commence cutting it as soon as you want it, that is oftentimes before there are any ears formed, is it not?

Mr. Sargent. If there were no ears, I should try to get along without cutting until the ears did form.

Question. What I want to come at is the difference in making milk between feeding it before the ears are formed and after they have formed. What difference in the result have you observed?

Mr. Sargent. I should say there is a great deal of difference, because my experience with fodder corn sown thickly, with no ears upon it, was that it was the very poorest green feed that I had used, while that with ears upon it was the best soiling crop I had ever used.

Mr. Dyer. Ex-Governor Hoard last year told us that some farmers had made failures in years past by trying to harrow in the peas, and he recommended especially that we should plough them in. As my experience in that direction years before had been a failure, I took his advice and ploughed them in this year. He recommended ploughing them in four inches deep on old land, not sod land, and sowing oats on top and harrowing them in. I followed his advice, and had complete success where I have had failure before. This year my peas grew the season through. There was no mould, no blight and no withering, and that is what he pledged us we should find if we followed his rule. I think brother Sargent would find if he tried it that there is no objection to doing it in the way that was recommended by Ex-Governor Hoard. Although he may be successful, another person who followed his advice might fail, because, if the soil was too heavy or too stony, he would not be able to get the peas in deep enough. Oats will grow all right when they are harrowed in.

The Chairman. We should be glad to hear from Professor Roberts, if he will favor us with a word on this subject.

Professor Roberts. Perhaps I can throw a little light on some of the questions that have been asked here in regard to feeding corn before it has made ears and afterwards. In our experience we have found that when corn was about tasselling out it was worth fourteen dollars an acre as feed, provided a ton of timothy hay was worth ten dollars. We used a ton of timothy hay for the unit, as we wanted something to compare it with. When this corn had tasselled out and made ears we found it was worth forty-seven dollars an acre, instead of fourteen dollars. I would like to ask the gentleman who speaks of raising corn how many stalks he allows in a hill usually, and what kind of corn he raises.

Mr. Sargent. I use the Longfellow variety, and set the machine so that it will plant four or five kernels in a hill.

Question. Is this a dent variety?

Mr. Sargent. No, sir; it is a flint variety, with very long ears and a small cob. We find that corn grown in that way is relished by the stock, and makes a liberal amount of milk.

Mr. E. Cushman (of Lakeville). I wish to ask Professor Roberts this question: When timothy hay is worth ten dollars a ton, what is mature or immature corn worth per ton?

Professor Roberts. I cannot answer that question off-hand.

Mr. Cushman. Then we do not know how many tons were worth forty-seven dollars a ton, and I cannot see that your experiment is of much value to our farmers.

Professor Roberts. It does not matter whether we have one ton or four hundred, because if we have one ton it may be worth as much to put into the silo as ten tons. That is just the point. I do not believe in filling a silo with wood and water.

Mr. Cushman. Do we understand the professor as saying that one ton raised to the acre is worth as much as ten?

Professor Roberts. No, sir; I did not imply any such thing. I stated that it did not matter how many tons were raised, provided the feeding value was there. I have studied this thing for years; I have experimented and proved that it was not the quantity that we wanted; and the discussion here has proved that it is not quantity but quality that you want. The worst weed to-day is the corn weed. There is no weed that is profitable at all. Now, we cut about twelve tons per acre, and when we analyzed it, and used a ton of timothy hay as the standard, we had forty-seven dollars' worth of cattle feed on an acre.

Mr. CUSHMAN. Then the inference would be that next year, if you get but one ton, the rule would still hold good, — that you would have forty-seven dollars' worth of ensilage. What we farmers want is to get at something tangible. There has been a great deal said about the value of ensilage as compared with English hay. Now, the professor takes one ton of timothy, calls it worth ten dollars, and compares that with an acre of ensilage. I do not know but that the professor is right, I presume he is; but we farmers are a little obtuse, and we cannot exactly see the point that one ton of ensilage is worth as much as ten tons of hay. We want something in this ensilage business that is tangible.

Professor ROBERTS. My dear sir, I have not said anything that implied that. I appeal to this audience if I have. I said the amount, if it was worth the money, did not matter. One man down in New York State says, "I have cut seventy-five tons of ensilage to the acre." I say to him, "It is not worth much to put into the silo." That man says, "I am going to raise one hundred tons next year, if I can." He has never raised it. Now, I said to that man, "It is real food that the animal can eat and digest that you want, not bulk, not water, not wood; you are raising wood in the form of a corn-stalk, and you are raising mud instead of albumen, and that is not the best way." I say that when you sow timothy and cut from two to three tons to the acre you usually have a crop of far less feeding value than when you plant corn as I do, get lots of ears on it, and cut twelve or fourteen tons to the acre. That is what I mean.

Mr. SARGENT. I think that is right.

Adjourned until two o'clock.

Afternoon Session.

The meeting was called to order soon after two o'clock by Secretary Sessions, who said: Mr. E. W. Wood of West Newton, chairman of the executive committee of the Board, a gentleman who is well acquainted with the subject we have to discuss this afternoon, will preside.

Mr. Wood. The subject selected for this afternoon's discussion reads as follows, "Fruit Growing in Massachusetts." This is a subject of especial interest to the farmers of this locality. Worcester County is the banner county of the State in fruit growing, and the fruit product contributes largely to the agricultural products of this county; and when we remember that by the national census of 1880, of the 2,461 counties in the United States there was not a county where the agricultural products equalled those of Worcester County; and when we remember that by the State census of 1885, of all the towns and cities of the Commonwealth, about 350, the agricultural products of the city of Worcester were larger than those of any other city or town in the Commonwealth (and it would be interesting to know how largely the fruit product contributes to this amount), — I think it will be admitted by those familiar with this section of the State that there is no other agricultural product for which as much is received that gets so little attention from the farmers generally as the fruit product. That product, especially the leading fruit product of New England, is to most of the farmers an incidental rather than a leading product.

The committee have selected to open the discussion of this question this afternoon a gentleman who can speak from a long practical and successful experience. I have the pleasure of introducing to the audience Mr. J. H. Hale of South Glastonbury, Conn.

FRUIT GROWING IN MASSACHUSETTS.*

BY J. H. HALE, SOUTH GLASTONBURY, CONN.

Mr. Chairman, Ladies and Gentlemen: — I regret, in the first place, to see so few ladies here, because wherever I find very successful fruit culture there I find the ladies thoroughly interested in it. I say to you, brother farmers, that you ought not to leave your wives, daughters and "best girls" at home. You ought never to come to a convention of this kind without the ladies.

The subject which has been assigned to me this afternoon, "Fruit Culture in Massachusetts," is such a broad one that it would really take up the whole of the rest of this session to just begin to talk about it, and if I did not see on the program the names of several distinguished speakers who are to address you this evening, to-morrow and Thursday, I should just start in talking and keep it up just as long as you could stand it. But that seems to be impossible, and it is also impossible for me in a portion of one afternoon to go into the discussion of special methods of fruit culture, covering all the varieties of fruit that may be grown in Massachusetts and New England. So I propose to say but very little in that line, but to talk on the general subject of fruit culture, from a business stand-point.

My own personal work and some public work in connection with gathering statistics of horticulture for the eleventh census of the United States has given me during the past few years an insight into the great and growing horticultural industries of this country. Horticulture is growing in some sections of the United States, South and West and on the Pacific coast, into a great commercial business, — just as much of a business as that of your manufactures here in Massachusetts; and in looking at the broad acres that have been devoted to orchards and vineyards the question always came to my mind, Where is the market? And on looking at the map of the United States, knowing the whole country as well as I do, I knew at once that New England was the best part of that market, because between the Mississippi River and the Atlantic Ocean and north of the Ohio River is where the people consume most of the fruits grown on the Pacific coast and in the South. I am speaking now of the deciduous fruits that may be grown here, not considering at all the semi-tropic and citrus fruit. Considering where the markets were where these fruits are to be sold; considering that nearly every carload of deciduous fruit that comes from California into the markets of Massachusetts could be supplied by Massachusetts farmers; considering that the freight tax levied by the railroad companies was from $300 to $600 per car, — for I saw six cars unloaded in New York two or three years ago on which the freight was $3,600, and similar carloads of fruit coming from the extreme South on which the railroad tax was from $200 to $300, — considering these things, I have wondered why the farmers of New England, who might save all that, or a very large part of it, and have the benefit of the market in addition, did not make a business of the production of this fruit. Much of the fruit coming from these distant points, as I have seen it grown, seen it gathered, seen it on its way, and seen it in the markets of Massachusetts and all through New England, sells well, sells at good prices, very largely because it is put up in attractive shape. The fruit packers are men who thoroughly understand their business, and pack their fruit in the best possible manner to stand this long transit and have it show up in a fine and attractive style in the market. They have studied the business in all its aspects, and know how to take advantage of favorable conditions of the market in any section of the country. The California fruit in most instances, even when allowed to ripen on the tree, is inferior to much that can be grown here; and it has to be picked in a green condition and has to take so long a journey that it bears no comparison in quality to that which can be grown here in Massachusetts; and yet there are hundreds of thousands, I suppose literally millions, of dollars paid by your people for fruit that might be produced here at home.

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* Stenographic Report by J. M. W. Yerrinton.

The great markets for fruit in the United States are east of the Mississippi River and north of the Ohio, but the very best of them all are in New England. Noticing the packing of fruit in California, in Colorado, in Texas, in the lower Mississippi valley, in Georgia and in Florida, I have noticed that if there was anything extra produced they sent it on here to New England, knowing that here is where they can dispose of their very choicest fruit at the highest prices, because here the people are ready to pay the most money for it. The reason is that wherever any class of people become more refined and more cultivated in their tastes the greater consumers they are of all horticultural products; and New England is where the people are the greatest consumers of fruit and horticultural products of every kind, — greater than in any other section of the country and probably of the world. You have that market right here at home, and why is not Massachusetts doing more to meet the demands of that market? Nobody can say that the market is ever oversupplied with choice fruit. There is often an abundance of inferior grade, selling at prices which do not pay for the culture, but rarely is the market supplied, and never oversupplied, with the choicest productions.

The present system of fruit culture here in Massachusetts, speaking in a general way, is that on every farm there are more or less fruit trees, apples especially, which, as the chairman well said in his opening address, receive no care whatever. The trees are simply put into the ground, and if they do not get broken by some stray cattle in the first two or three years of their lives they may in time be able to "paddle their own canoe," and even under the most adverse circumstances give some return to their owners. They pay no tax on the trees, do not spend any time or money in pruning them, fertilizing them, or cultivating the soil, and when the time comes to sell the fruit they send it to the nearest local market, packed in a hap-hazard way, and take what they can get for it. Very often it is a disgrace to the market and to any farmer who brings it there.

Small fruits are grown more as a specialty, and often pay handsome profits. A few peaches are grown as a specialty by some farmers, and as this is done with more care and the fruit marketed with more intelligence, there are better profits. The only way, it seems to me, out of this difficulty is to go into the production of fruit in New England as a matter of business, — go into it from a business stand-point. I try to urge upon people who are setting out trees for a little orchard or a great orchard to study the business of growing fruit just as successful cattle men study their business. Make a business of it, study it and understand it, just as your sharp, alert dairymen study the subject of cattle foods. That is just what we have got to do, if the business is ever to be what it ought to be. In the first place, study yourselves, then study the plant, the soil and the market, and then there will be your opportunity. There is a growing desire for knowledge of these things, but on the whole it is hard to find any considerable number of farmers or fruit growers who *know* very much about the business from a business stand-point.

Three years ago I was placed in charge of five special horticultural investigations of the Census Bureau at Washington, and one of the things I had to do was to learn all I could about certain fruit interests of the country, — about the soils, the varieties, the markets, the picking and handling, and the work all the way through; and I got up a schedule of questions that I sent to the fruit growers all over the country. I had the names of all the fruit growers in the United States who produced anything for sale, and of all the commercial men who handled these products, and I sent one of these schedules to every man whose name I had, asking for this information. I am ashamed to say, brother farmers, that I often got more information in regard to the growing and management of fruit say in Worcester County, Mass., from some men in the city of Boston who were dealers than I could get from any farmer or fruit grower in Worcester County, taking it as a whole. I wanted to learn something about certain branches of fruit culture in the lower part of the State of Alabama, and I thought if I could get hold of some men there engaged in fruit culture I could get the desired information; but I found I had to go to men in the city of Mobile, a commercial community, to get it. I wanted to know something about the fruit productions of the Mississippi valley, and although I found some gentlemen there who were willing to help and who did furnish much information, yet I obtained more, and information that was of greater value, from certain commission men in St. Louis than from any of the fruit growers in the Mississippi valley. And yet we complain that the middlemen get all the profits! Why? They understand the business end of the matter, while the fruit growers understand only the hard-muscle drudgery of it. We have got to come down to that, and understand fruit culture and fruit marketing from a business stand-point, and then we shall place it where we want to place it and where it ought to be.

Now, I presume there are a number of farmers here present who would love dearly to take their wives and daughters and spend the winter in Florida, but they think they cannot afford it. I know one bright, energetic farmer from a neighboring State who has gone to Florida with his wife and two daughters to spend the winter on the profits made from handling the apples raised, I will not say by Worcester County farmers, but it comes pretty close to it. He studied the fruit markets all this summer, and found out all he could about the fruit supply. He found that up in this part of the country there were more apples than in any other section of the United States of the same size, and he bought a large quantity at from $1.00 to $1.25 per barrel; he has been selling them for from $2.00 to $2.50 a barrel, has got a nice little bank account, and has gone to Florida on the strength of it. And yet here in Massachusetts and all over New England the farmers believe that the middlemen absorb all the profits and they get only the hard work. They are satisfied that apple growing does not pay. This gentleman to whom I have referred is satisfied it does not pay them, but it pays him.

Then another point in the same line. Careless packing is a constant source of trouble and loss. Not long ago two pickers-up of apples from the Western States came to my place and wanted a few carloads of apples. They offered me from $2.25 to $2.50 a barrel on the track at Hartford for apples of my own packing (they were men I never saw before, I did not know one of them), and 50 cents less for "farmers' packings." What did they mean by that? I do not know, but I guess at it. They wanted to pay 50 cents less per barrel for farmers' packings. The apples were grown by farmers, for I had got them from farmers, but somehow or other they had got the idea that my brother and myself had been trying to handle fruit and trying to make money out of it from a business stand-point, and would try to make the apples look well, and yet honestly packed all the way through each barrel, and in such shape that they could make from 75 cents to $1.00 or perhaps $1.50 a barrel, because they could guarantee every barrel.

As some of you know, we have been trying to grow peaches on our farm in Connecticut. We have been fooling a little with peach orchards for twenty years. In 1887, I think it was, we had a large crop, and we made up our minds that we had grown good fruit; at least, it cost us enough in hard work, fertilizers and labor, and many other things. We thought it was extra good, and worth something, and we ought to have the profit if there was any in it, rather than the terrible middlemen. So we decided to sell our fruit directly to the dealers, rather than to ship it to commission merchants and let them get a portion of the profit on it. We made up our minds that we would have a store of our own in Hartford, eight miles from the farm, and sell that crop of peaches directly to the retail dealers; that we would pack them on a certain plan; grade to three uniform sizes, pack each grade by itself, and have the fruit in the middle and bottom of each basket just as good as that on top, and every basket labelled and guaranteed. After making up our plan of packing and handling, I went out to see the retail dealers in different cities. I found out the men who were handling the finest goods in the fruit line in any particular town, who had what is called "the gilt-edge trade," the nice families, who would be likely to buy the choicest fruit. I interviewed a number of such men in the large cities and towns, and told them what sort of fruit we believed we had; that we proposed to handle it in a certain way, pack it, and sell it directly to them by grade and brand, the larger peaches being of a certain size all the way through the basket, — just as many of the choicest ones in the top as there were anywhere; another grade a little smaller in size, sorted according to the same standard, and absolutely the same all the way through; and still another smaller grade up to the same general standard of grade all the way through. Then I told them that we would label them and guarantee them. I talked to these dealers in that way. Well, of course they wanted to say something, and they all said much the same thing, though in different language, but the sum and substance of it all was: "You look like an honest farmer, perhaps you mean to be; but we have never yet found a farmer who *knew* how to put fruit on the market. Perhaps you would like to do it, but you cannot do it if you would." That is practically what they said. But they wanted to encourage me a little, and so they said, "You think you are going to do something, and when you get your fruit ready, come in and perhaps we will give you an order." That was all I could get out of them. It was not a very pleasant thing to hear, but that is the way they met me. I am not going to tell you how it came out, — it might appear like boasting.

Now, these are homely truths, but they are truths that ought to be in the mind of every farmer in Massachusetts or anywhere else who proposes to make a single dollar out of fruit culture; and, if he does not have these truths clearly in his mind all the way through, he had better keep out of the business. It is no place for him.

With reference to the question of markets, as I have said before, you have the best of markets right here at your doors. They are always with you, and they are going to increase.

As to the question of soil, nearly every acre of tillable land in Massachusetts is capable of producing some class of fruit, and producing it profitably. So there is no question about the soil conditions. The soil conditions of New England are right for producing the very best fruit that can be produced in America. I do not know any locality where finer apples are grown than are grown in Worcester County; and yet you are letting other sections supply the best markets for fruit products to be found anywhere. Worcester

County can produce the very finest apples in the world; it does produce them very often under only moderate conditions of culture and care. I am speaking, remember, of the production of fruit from a commercial stand-point. The soil is all right. The thing to be considered in going into the culture of fruit is, Is the *man* all right?

I do not believe that a man ought to be in any branch of agriculture, in mercantile life, in professional life, or in any business, who does not get a daily pleasure out of his business. I pity any man who is in any branch of business or in any profession who is not getting some fun out of his business. Every man ought to get anywhere from six to a hundred per cent cash profit out of his business, and then three or four hundred per cent in fun out of it. Looking at it from that standpoint, I believe no man should go into fruit culture whose heart is not especially adapted to it, because he will not succeed as well as he ought unless he has that kind of heart; and when the man is all right, his own particular soil and situation require to be studied. I would not advise a man who is located on low, swampy land to attempt peach culture, and I would not recommend a man who is situated on a very light, sandy plain to go into pears on that land. Every man should study his own particular soil, and then he can find some classes of fruit that will succeed there. Then, of course, very much may depend on his market. If he is situated near a small city or village, like, for instance, this beautiful village of Spencer, and wants to supply that market, I would not advise him to go into a tremendous great apple orchard, and neglect pears, peaches and the small fruits. I would advise him to have a list of the fruits that this market will take and consume through the whole year; while, if he is on some great railroad, so that he can reach Boston, Worcester, Springfield, and the cities to the north and south readily, then I think it would be better for him to devote his entire energies to a great peach orchard, or a great apple or pear orchard, or small fruits, — strawberries, raspberries, blackberries or currants. He might grow any one of them. All these things depend upon the man himself, his soil and his situation. I cannot lay down a law as to which he shall take up.

As to the question of varieties, that depends so much on outside issues, local issues, — as we heard some years ago that the tariff depended wholly on "local issues," — the question of varieties depends so much on local conditions that it would be of no use to go into it here at this time. It depends much on the soil, much on the markets, much on the climatic conditions. There are all those things that each individual must work out and find out for himself in his peculiar situation, and no one man, no dozen men, can tell him off-hand what to do. That is a matter depending largely, as I say, on locality and soil. Of course there are a few standard varieties of apples, pears, peaches and plums, that, as a general rule, do well anywhere; but if a man is going into the business of fruit culture for profit he must study it from his own stand-point. For instance, I am located only eight miles from the city of Hartford, and I cannot grow the Beurre Bosc pear; and yet in the city of Hartford they can be grown better than anywhere in America. So these things will come in all the time.

In these days of consolidation, co-operation, trusts and monopolies of all kinds, which are bad in one way and wonderfully good and productive of beneficial results in another way, it seems to me that there is a good opportunity for the development of horticulture on the line of co-operation. The man who has a "general-purpose" farm and is producing all sorts of crops, and among other things has twenty-five, fifty or seventy-five apple trees scattered about his place, who does not have time, or will not, at any rate, prune them and fertilize them, because he is very busy with other work, who has not the time to pick them just in the right stage of maturity, and has not enough of them to get first-class new barrels to pack them in the proper shape, but jumps at it in a rough-and-ready way, and markets them in all sorts of ways but the right way, — for such a man there is no money in apple culture; and that is the way that most of the apple trees in New England that do not pay very much profit are treated. I believe, Mr. Chairman, that the apple orchards of Worcester County, Mass., alone, if handled properly on a business basis from last April to this first day of December, would have put at least $300,000 more in the pockets of the farmers of Worcester County than they have to-day. Quite a nice little profit lost on one season's crop. That is a good deal of money, and they could use it to good advantage, most of them. Some of them would not want it, but they could get rid of it among their neighbors. But with the situation as it is, with the tendency towards cheaper production and better handling, it seems to me there is a wonderful opportunity for co-operative apple orchards. Large and small farmers adjoining each other might take down their fences and walls and make one great apple orchard of fifty or perhaps a hundred or two hundred acres, and manage it with the same care and from an emphatically business stand-point as the successful manufacturers of Massachusetts manage their business; and the apples could be sold at prices which would return a good deal more than ten per cent on the capital, — probably twenty, perhaps thirty per cent. That seems to me a wonderful opportunity for farmers to co-operate in a way that would bring tremendous results. That may not be possible everywhere, for the farms may not be just suited to it, or the men. The farms might be suited to it, and the men not. Just as likely as not the men would not work together. But where they would work together there is a grand chance for a business venture that would be much better than lending money on Western farm mortgages. It would be a great deal safer, there would be lots more fun in it, and it would be better for Massachusetts. Where the farms were not properly situated for that work, there might be opportunities for co-operation in another way. Some men may have farms that are not adapted to the growing of small fruits but just suited to orchards. These farmers have the farms, the skill and the energy, but not the capital. There is an opportunity for the men of capital to join hands with the farmers, the men of means furnishing the capital, the others the lands for orchard planting, and develop large orchards in that way; and not only large orchards but large vineyards, and great fields of small fruits. Many of the small fruit cultivators of to-day are unsuccessful financially, and one of the reasons of their want of success is thought to be the lack of a sufficient supply of moisture just at the right time. They cannot afford to put in an irrigating plant, costing $3,000, $5,000, $10,000 or $20,000, for two or three or five acres of small fruits; but they could have a co-operative field of fifty acres, which would well repay an expenditure of $20,000 for an irrigating plant. So also in regard to spraying orchards. Many of you who have a few trees do not spray them because it takes too much time, and you do not want the bother and fuss of mixing a lot of arsenical poison and applying it at the right time. It is a somewhat expensive job if you have only a few trees, for it will cost ten or fifteen cents a tree; but with a large orchard it costs but very little, — not more than two cents a tree. So in the matter of cold storage. A small farmer does not have it because his business is carried on upon too small a scale, and when his fruit is gathered he must get rid of it at once, because he is not prepared to handle it in a way to secure the best prices. He must take it to the nearest market and sell it for what he can get, because no one comes after it. No dealer came all the way from St. Louis or Denver this fall to see the farmer who had ten or twenty barrels of apples in his cellar. A co-operative farm association that had one, two, three or ten thousand barrels of the standard varieties of apples would have buyers every day in the week. They come for them where they are concentrated. Instead of allowing $2.00 or $2.50 a barrel for one lot of apples and for another lot of "farmers' packings" 50 cents less, they would meet you at the higher price and would be glad to do so.

So in regard to packages. Undoubtedly much of that work could be done in the winter. A good many farmers do not have enough to do in the winter, some have too much; but where there was a co-operative association of that kind the work of barrel or box making could be done at that time. Then there would be an opportunity to get the management and control of the markets, and the farmers would get the profits without the intervention of the middlemen. There is a wonderful opportunity, it seems to me, for co-operative work in that line. I believe it will come to the farmers of New England just as it had to come to other business, and with a wonderful saving.

You have all heard of the Standard Oil Company, — what "a wicked combination" it is, and of "the great harm it is doing to the people of the country." Well, it is a terrible monopoly, there is no question about that; it has starved out a great many of the small operators and many have suffered by it, while some of the men concerned in it have made enormous fortunes, some of which money is perhaps used to advantage and some of it poorly; but there was never a time when we could buy good and pure oil as cheap as to-day. Ever since the Standard Oil Company was organized, good and pure burning oil has been growing cheaper and cheaper all the time, so that consumers throughout the whole of the United States are benefited by that. Yet we hear complaints of their rolling up their millions. I say that it is just that co-operation and consolidation which has enabled them to do it. When there were hundreds of little oil refineries in the country, all the waste coming from the manufacture lay in piles here and there all over the country; and when the Standard Oil Company got hold of the business of refining and consolidated the works they did not know what to do with these piles of waste. They had to do something with it, and with that accumulation of capital they could afford to hire expert chemists, and they did hire, as I am informed, twenty men, none of them with a salary of less than $2,500 a year, just to work over that mass of rubbish and see what there was in it, if anything, that was valuable; and to-day there are over two hundred distinct articles of commerce being sold on the market which are the products of those waste heaps. There is an enormous profit there, and we are getting better and cheaper oil. I am not here to uphold that trust, I am not here as its advocate, but it shows what can be done by co-operation.

Of course I do not look at this thing as if we were going to rush into co-operation. Farmers do not go off in that way. There is an independence in farm life that men love, — an independence that can be found nowhere else. I like to see an independent man, I like to see an independent farmer; but are we not likely to carry that idea of independence a little too far? While we can "go it alone," is it best that we should? But, as farmers are situated at the present time, and as they may be situated for some centuries, perhaps most of them will "go it alone." Many fruit growers will "go it alone" also; but it is for the fruit grower who is going it alone to study the situation pretty closely. There are opportunities for him to study the scientific side of it, that is, the side of plant nutrition and cultivation, the question of the insects and fungi that work injury to fruit. There are wonderful opportunities through the work of our experiment stations and our agricultural colleges to obtain information, which is free to every one who will ask it, and it does not cost much to send a postal card; so that there is no reason why an individual fruit grower cannot be well informed, if he will only take a little trouble. The people of New England have far greater opportunities for supplying the markets at home and saving the profits which go to the railroads from the fruit products brought here from the South and West than the people in any other section of the country. It is an added advantage that you can daily or weekly go into the markets and study them. That must be done if you would be successful. Study the markets; see how the fruit arrives there, see why certain varieties sell better than others, and see why at certain seasons certain packages among a number sell for more money than the others. But after studying and knowing all these things, even then I believe that the man, instead of undertaking to grow a great variety of fruits, should as far as possible have a specialty, and produce only one or two varieties, aim to produce them better than anybody else, make a name for his fruit, make a name for himself, and he can get a great deal more for every barrel, basket or package that he sends to market. There is a wonderful deal of profit in a good name.

Some one asked me at the hotel to go into detail this afternoon in regard to the methods of preparation of the soil and the feeding of the soil for these different fruits, and the general methods of planting. It seems to me that in a single afternoon, especially in view of all that has been published and is continually being published in all the agricultural and horticultural papers, and the abundant knowledge that is circulated abroad in the plant and nursery catalogues, it is hardly worth while to go into those things here; but when the time comes for questions on any particular point in the line that the gentleman who spoke to me had in mind I will be glad to answer them.

There is one thing that applies to fruit growing in Connecticut, and it applies to Massachusetts equally well, and that is this. The climatic conditions of New England are somewhat trying, especially to fruits, and it is well to study the climatic conditions of our farms in relation to the different fruits that we may plant. The more ordinary fruits we can grow almost anywhere, the more tender ones want selected places. It has been perfectly astonishing to me in my peach orcharding to find what variations there were in the temperature within very short distances. I know that some years ago a member of my family who kept a record of the temperature from day to day, and a friend living only half a mile away who did the same thing, used to find upon comparing notes that in extremely hot weather our place was some two or three degrees colder, and in extremely cold weather we were some two or three degrees warmer. That was the difference in temperature between places only half a mile apart. Of course the friends often exchanged thermometers in order to prove that the variation was not due to the thermometers, but was really due to climatic differences. We all know that frost will run down hill just about as quick as water. We have one of those long, narrow farms, fronting on the Connecticut River and running three miles back. Our ancestors bought as large a frontage on the river as they could, half a mile or three-quarters; but as generation after generation came along and wanted a farm, they split the land through in the middle, and repeated the operation until some of the farms have a width not greater than twenty rods on the river, and yet a few still hold the full three-mile length. Our farm goes from the lower levels of the Connecticut River back to considerable elevations, twenty-two rods wide and a mile long. I have been out over the farm early in the morning a good many times when looking after the peach buds, and when I would go down hill I found that the thermometer sunk four or six degrees, and then when I went up on the other side it would go up, and down in the hollow it would be down again. I found also, as probably many of you know, that it is not so much the exact elevation which you reach; that is, an elevation of six hundred feet of broad, level territory will not shed the frost as quickly as an elevation of two hundred feet with a sharp descent close by, so that the frost can run off very quickly. That is a very important thing to know, especially in planting any of the tender fruits. A steep hillside or an elevated hill where there is low ground close by, or a ravine running close by, is favorable for fruit growing. The ravine will drain the frost as it will drain water, and it will work wondrous results in saving fruit. I presume that is the reason why there are many sections in Worcester County where peaches can be grown when they cannot be grown in other sections of your State.

Speaking in a general way, the small fruits, the apple, the peach and the plum need a pretty thorough preparation of the soil and a pretty continuous annual culture, — stirring of the soil, as Professor Roberts puts it, — in order to secure good results. On the other hand, the quince and the pear will not stand it so well, and can be more successfully cultivated by mulching, — mowing the grass and letting it lie there on the ground. Yet I believe in thorough culture; it must be done, but it must be done at the right time. A gentleman wrote me two or three years ago that he had tried to follow some of my ideas of culture, and had ploughed his peach orchard three times that summer, and it was going down hill. No wonder that it was, because the plough would tear the roots all to pieces. One ploughing was enough, and that early in the spring. I find a great many make the same mistake in ploughing apple orchards. And they make a mistake also in planting their orchards. They set out the trees thirty feet apart, and then they think they will do well to get something in between them — peaches or plums — that will be short-lived, and then perhaps another line of trees among them; and they rely for the support of such orchards upon fertilizing them. I believe in carrying all my eggs in one basket, and watching the basket. So I believe in a special line of work. I believe in having an apple orchard entirely by itself, so far as any crop is concerned, and a peach orchard entirely by itself, so far as any crop is concerned. Keep them alone; don't mix up orchards.

Regular planting is important; that is, planting at regular distances and in straight rows. That enables you to have very much cleaner culture, and then it looks better; and my idea is to get a lot of fun out of *looking* at trees and fruits. There is a pleasure in seeing them grow. I know that in our peach orchard in Connecticut, when the fruit buds were killed and there was no hope of getting any crop that year, I have had hours and hours of pleasure in walking through the orchard or sitting on the fence and just looking at the trees. You do not plant an orchard simply for the pleasure of looking at it, and of course I am not recommending you to do it; but I say you better have it in such form that you will take pleasure in looking at it. Some of my own orchards have been simply planted by ploughing the ground as straight as it could be ploughed, checking it off in that way, and setting out the trees there, and we found them not quite even enough; others have been planted by a regular survey. Never until I planted an orchard in the South did I find a man who could plough a straight row. I wonder if Professor Roberts has found it out as I did. He gave us a lot of "taffy" about Massachusetts Yankees being so much wiser than the farmers over in New York State. I do think the Yankees are a pretty smart people, that we here in the North are a pretty lively set of men; but I never was able to find a man who could plough an absolutely straight row until I went down South and gave my negro a mule and told him to go to work and lay off rows to set out a peach orchard. I have got a line of peach trees in rows more than a mile long that I do believe if you put a surveyor's transit on it you would not find a tree two inches out of line. I never saw anything like it in my life. The trees are as straight as a string. Did you find anything like that down in Mississippi, Professor Roberts?

Professor ROBERTS. They know how to draw lines crooked and keep them at equal distances.

Mr. HALE. There is no getting by that man. He will make a crooked row straight.

In order to manage the business part of fruit culture there should be from the beginning an everlasting faith in your business and in the markets that you supply. Your aim should be to grow only the very best of fruits; you will have poor ones enough anyway; and after growing them the very best you can, pack them in the most business-like manner, in the best style, in the most attractive-looking packages; pack them all the way honest from top to bottom, and yet make the top just as pretty and attractive as possible. You cannot put on too much style. People buy fruit to eat, and yet the proper way to get them to buy it is to please their taste, — not the taste of their mouths, but the taste of their eyes first. Give it an attractive, showy appearance, and then you can get your money for it. I have a neighbor who produces small fruit for the market. He is a most thorough cultivator and a most careful and close inspector of his packers. There is never anything of a poor quality, never any unripeness or over-ripeness in his berries, they are packed in the best and freshest-looking baskets, and then he goes into the market and gets from forty to sixty per cent increase per basket over the best. I never knew him to overload the market. You have a cultivator here in Massachusetts, A. G. Sharp of Richmond, who is growing fruit in the same way, who grows the very finest berries I know of in the State. He grows raspberries, blackberries and currants, and has made more money the last two years on two acres of currants than most of you have on any two acres on your farm. He does it by thorough cultivation, by liberal feeding, careful picking, and stylish but honest packing. He goes so far in some markets as to put his card in his packages, giving his name and address, and then saying on the bottom, "Price always five cents above the market." But his demand is always greater than his supply. These men do not begin to fill the markets, and they never will, because Massachusetts is on the upward grade, and working higher and higher in its taste and refinement and in its demand for an abundance of these good things.

Now, all this is from the commercial stand-point, from the business stand-point, from the stand-point of getting greater cash returns to the farmer. But there is another side to fruit culture, and that is for the home supply. That is the biggest market of all, that is the best market of all. Hundreds of farmers and hundreds of small home owners in Massachusetts are working hard six days in the week to earn money from some farm crop or some vocation in life to go into the markets and buy home comforts, while at the same time they are not having the home comforts of fruit that they ought to have. There are hundreds and thousands of farmers in the State of Massachusetts who do not have a full supply of wholesome, healthy fruit. They ought to be ashamed of it. There is a market that is not supplied. Their wives and children are hungry, — yes, just *hungry* — for good, wholesome fruits. They are feeding them on pork and potatoes, or else going to market and spending their hard-earned money to buy some other foods that are not as wholesome, not as tasteful, not as refining, and also making a great deal more work in the house to prepare that food for the table, while they neglect the fruits that lie right out in their own soil, if they would only develop them. The soil is just full of delicious strawberries, raspberries, blackberries and currants. Every acre of Massachusetts land is just chock full of them; all you have got to do is to work them out, and it is not so very hard work, either. I have a friend in Connecticut who is a manufacturer, but he keeps a little half-acre of ground for a fruit garden, and charges up all the fruit that goes into the house at the market prices, and he calculates that he has got at the rate of about seven hundred dollars an acre off that piece of land annually. It pays him better than any of his manufacturing industries, his family is a great deal better satisfied, and his neighbors too. He has not only enough for his family, but enough to give to his neighbors and make them happy.

I think perhaps, Mr. Chairman, I have talked long enough on this line, and it would be better for me to answer any questions that the audience may desire to ask than to take up any more time in talking upon matters which, however interesting they may be to me, may not interest you so much.

The Chairman. The speaker has said that the question is so broad that he could not take it up in detail and discuss it properly, and he has left it open to you. If you wish to ask any question on any particular phase of fruit culture, you have now an opportunity.

Mr. Dyer. With what do you feed your peach trees?

Mr. Hale. With chemical fertilizers solely. Potash in some form, the cheapest form in which we can get it, and phosphoric acid. The phosphoric acid has always been supplied from fine-ground bone, the potash mostly from high-grade muriates. We sometimes use Canada ashes, but potash in some form is always used. We do not apply nitrogen except what little comes from the fine-ground bone and from the ploughed-in clover. When the trees are first set, large holes are dug and in the earth that is put back there is considerable fine bone, perhaps two pounds of bone to a tree. After the tree is set potash is spread on the surface round the tree, and after this first year it is always spread broadcast over the land. These two fertilizers are never mixed. We think that the more sandy portions of the orchard ought to have a little more potash, and we can best supply this by spreading them separately.

Question. How much to the acre?

Mr. Hale. That has always been all we could afford, and sometimes more. But, to answer you in a general way, about twelve hundred pounds of bone to the acre, and from four hundred to eight hundred pounds of muriate of potash. Probably the muriate of potash would average about five hundred pounds to the acre. That is an excessive application of potash, but we want to give just as much as the trees will use, and a little more.

Question. Is not that quite a large proportion?

Mr. Hale. It is a pretty good proportion, but we have felt that we would rather have twice too much than regret having a single ounce too little. Every year since the trees were planted they have had it, and they will get it as long as they live, if we can earn or borrow the money to buy it with.

Professor Roberts. As between the different salts of potash, muriate, kianite and sulphate, which would you prefer?

Mr. HALE. Sulphate by far, but I would prefer ashes to anything.

Professor ROBERTS. Why?

Mr. HALE. Because wherever we have used ashes we have had the best-colored and the best-flavored fruits. I prefer to apply potash in that way simply because the trees say so. I do not know anything about it except from what they tell me. Cotton-hull ashes make an excellent fertilizer for peach trees.

Mr. L. S. RICHARDS (of Marshfield). I notice that Mr. Hale has not said much about peaches, with which he has had great success, but he has said considerable about apples. I do not know how it is in Worcester County, but I know very well that in Plymouth County there is a great deal said against raising apples, and few farmers seem to want to go into that business. They have not made it a success. But on the old Daniel Webster farm in Marshfield there is an apple orchard of some three hundred and forty trees that were planted by Daniel Webster, and those trees are every one of them Baldwins. They bear every year. I went over the orchard some time ago to make an estimate, and I thought that those three hundred and forty trees would yield about nine hundred barrels. I have not been there since the fruit was picked, and do not know how it turned out. There are about a hundred head of cattle on the farm, and every night they go into this apple orchard and eat up all the apples upon the ground. It is a rare thing to find a codling moth in the orchard, and the apples do not show any signs of it. It seems to me that this proves that putting cows into an orchard where they can eat up the apples that fall and also manure the land is of advantage to the crop.

I believe in apple raising. I have started an apple orchard which is just commencing to bear. I have great faith that with proper manuring and cultivation that orchard will pay well. I know that Dr. Fisher has been very successful in raising apples, getting some three or four dollars a barrel. I would like to hear a little more about peaches from Mr. Hale. I know in our county, in the towns of Scituate and Marshfield, there have been several who have gone into raising peaches. I recollect one man especially, who has a very large farm. He had about a thousand trees on a hill, and I do not think that he ever got a peach off of those trees. He cut them all down when they were five or six years old. Dr. Ham, also of my town, set out some three hundred trees, and he never succeeded in raising anything to speak of. I have been as successful as any one there with peaches on a small scale, — perhaps an acre or so; I do not know how many trees. A few years ago I made a hen fence around my peach orchard, which was on the north side of a hill. In that way I succeeded in raising large crops of good peaches. But they were native trees. Two years ago I removed the hen yard, and then I did not succeed in raising any crop. I put the hens back into the yard, and I have now a few nice peaches. I attribute that mostly to three causes: to the hens, that pick out the worms and scratch the ground and keep it cultivated, to putting the trees on the north side of a hill, and to the fact that they are native trees.

Mr. Hale. Of course the gentleman does not expect me to go into a long talk about peach culture. He has mentioned the fact that a neighbor of his planted a peach orchard of a thousand trees, cultivated them well for a few years, and then cut them all down because he did not get the crops he anticipated. I think he said the trees were about five years old when they were cut down. If a man has no more spunk than that, he ought not to plant peach trees in Massachusetts. Of course he would make a failure of it. A man who cannot wait more than five years will get left.

Now, our extensive planting of peach orchards began in 1878 or 1879, and the trees ought to have borne a crop, according to all reason, in 1882 or 1883; but in the spring of 1883 the buds were all dead, and they were dead in the spring of 1884, and we had put into them all the money we had the good luck to scrape up, because we never had a dollar that we did not dig out of that old farm. But we wanted more fertilizers, the fertilizer men wanted more money, and we had to ask some good friends to endorse our notes that we might get more money at the bank. We were advised to cut the trees down and go into something else, but we were not in the business that way; so we borrowed money and cultivated and manured the orchard again. In 1885 the buds were dead, and we had to borrow more money. In 1886 it was the same; and people said, "Boys, you are on the wrong track; you are just going to pieces yourselves, and breaking everybody else." But we did not think so. We borrowed some more money, and cultivated that orchard just as well as before. We were in debt on that orchard seven thousand dollars. I don't suppose that the farm was worth more than three or four thousand dollars; in fact, the members of the church society, who had a mortgage of two thousand dollars on the farm, shook their heads and said they must have more security. The next year we got between nine and ten thousand dollars out of that peach orchard, and paid off the mortgage that the church held on the farm. I have signed a good many checks for a larger amount than that since then, but I never signed one with quite so much pleasure as I did the one that paid off that mortgage.

If you go into peach culture, you must not expect to get a crop every year, because the frost will catch you every now and then; but when you get a crop what fun you will have, and how your neighbors will say, "How lucky you are!"

Mr. Geo. Cruickshanks (of Fitchburg). It is a very important thing to know what varieties of peaches Mr. Hale would recommend for planting in Massachusetts.

Mr. Hale. There are a few of the standard varieties of peaches that are more hardy than others, — hardier in wood growth and hardier in fruit bud. In our earlier plantings we planted some twelve varieties of the leading standard sorts of that time. We have found that on the whole the yellow-flesh peaches are more tender in fruit bud, — that is, the Crawford, the Foster, the Richmond, and peaches of that class, have been more tender in fruit bud than the white-flesh varieties. We have found, as you have all found if you have grown the very early varieties at all, that, although they may be very hardy, they are poor fruit for the market. We wanted a moderately early variety, which we found in the Mountain Rose, which ripens in central

Connecticut about the 20th of August. Then we had the Old Mixon and Stump the World. Those of the old standard sorts have been the three most reliable first-class peaches. We have had in addition to these a yellow peach, Hill's Chili. It is grown somewhat in Michigan, and is an orange-yellow all over, with no blush about it; if grown on unthrifty trees, it is woolly enough to shear; but if grown on well-stimulated trees, and the wood thinned out very freely, it produces a fruit that is of fair appearance and delicious quality. That is the only yellow peach of the old standard varieties that we have found reliable. Then the Keyport White that you find in the market late in September, sold as the Morris White. That is a hardy and reliable peach. If gathered before it has matured, before it gets really white and creamy, it will be occasionally greenish and will be unsatisfactory. But these varieties have given us satisfactory crops whenever we have got any crop at all. Hill's Chili has produced every year since it began to bear in 1883.

Secretary SESSIONS. Will you tell us about thinning and pruning?

Mr. HALE. Thinning is a double-ended business. We plan to prune our trees annually. We shorten in the new wood of last season's growth from one-third to one-half. It is on the new wood that all the good fruit buds are. If I were to trim an orchard just for the sake of the tree itself, I would trim any time in the fall after the foliage had dropped; but with us there is a liability of the frost killing the buds, and we leave the trimming until the fruit buds begin to swell in the spring, which is the latter part of March or early in April. Then we go into the orchard and trim the trees. Many times we have fair crops when ninety-five per cent of the buds are killed. With ninety per cent of the buds killed you can get good crops, by judicious pruning, cutting away only such branches as have few if any live fruit buds, and leaving those that have buds alive, regardless of their position on the tree or their relations to one another. This method of pruning does not make the prettiest tree in the world. I will wager that I have more homely and ill-shapen peach trees than any man in America. I will wager again that I have made more money out of them than any other man. It makes a bad-shaped tree, but it gives us abundant crops. We do not thin the fruit very much until after the pit is formed in the peach, because there is what is called the "June dropping," and it would be rather unwise to do the thinning until nature has done its share; but after the fruit has set for a full crop, then we go in there with our men and pick off the surplus fruit. In a general way we aim to get the fruit off so that there shall be no two peaches within four inches of one another, and many times even six inches. That is the general rule we go by, and we try to impress upon our men that that is what we want them to do; but we find it the most difficult thing in the world to get men to thin fruit enough. It looks terrible to attack a tree that is loaded, and take off about all the fruit, — cover the ground with peaches as big as walnuts, and only leave a few on the tree. It is the most difficult thing in the world, as I say, to get our men to do it. My next-door neighbor, a kindly old gentlemen who has lived there all my life, who when I was a small boy was very kind to me and has helped us all through, when, in 1889, I set some boys at work thinning the fruit, came to me and said, — calling me by my Christian name, as he always did, — "Do you know what those boys are doing out there? They are tearing all the fruit off your peach trees." I hitched up the horse, took him in the carriage and we went to the orchard. When we got there I said, "Mr. Kinney, the boys are not doing enough; they ought to take off twice as many as they do." You can hardly thin the fruit too much. You may thin, and thin, and then thin some more, until you get the three grades of peaches that I spoke of. We have one label for what we call the extra red grade. We are patriotic sometimes, and we took red, white and blue for our colors, — red for the extra size, white for the No. 1, and blue for the seconds. Now, there are about seventy-five peaches of the extra red-label grade in a half-bushel basket; the No. 1's do not look very much smaller, but there are one hundred and twenty-five to one hundred and fifty in a basket; the seconds have from one hundred and eighty to two hundred and twenty-five in a basket; so that there are about three times as many peaches in a basket with the blue label as there are in one with the red label, and the No. 1's will sell for three times as much per peach and the extra red grade for six times as much per peach as the seconds; and the seconds will exhaust the tree nearly three times as much as the extra reds, because it is the pit in the peach that exhausts the tree, and a tree that overbears always exhausts itself. I have had people come into my peach orchard and say, "You have got a splendid crop," and I had, but I had to prop the trees up, and then after one crop they died. They killed themselves by overwork. So that thinning pays in preserving the life and vitality of the trees, and it pays also because I can get six times as much per peach for the highest grade as I can get for the lowest.

Secretary SESSIONS. I would like to ask the speaker whether he thinks thinning apples would pay.

Mr. HALE. I think it would. It would pay you to give much better care to your apple trees than you do. I tell you, if I had an apple orchard that is treated as most of your orchards are, I should be ashamed to look a good honest apple tree in the face.

Mr. WARE. How many years will a peach orchard continue to give paying crops of peaches?

Mr. HALE. I do not know; I have not got there yet. We have some trees that are fourteen years old, and the finest fruit we had this year came from a fourteen-year-old tree. We got more fruit for which we used our red labels from a tree fourteen years old than from any other tree. They are not all dead yet, although of course there are many missing trees in that old orchard.

QUESTION. Do you trim a young orchard as you do an old one?

Mr. HALE. On the same principle, but the trees do not make wood as rapidly, and so do not require so much trimming.

QUESTION. How long did you ever know a peach tree to live?

Mr. HALE. I know one in Connecticut that is a little over a hundred years old. There is one on our farm that is over sixty, and one in Woodbury, Conn., about fifty years old. I am a young man, and I do not know how much older they may be; but those are old native trees, and probably the survivors of hundreds that have gone down.

Question. In selecting the ground for a peach orchard, would you take the highest elevation, even though the ground was heavy soil, or would you take a more level plain, with a lighter soil?

Mr. Hale. I should prefer the greater elevation, if of the character to which I have referred. I know we have some high hills that are nicely situated for the growing of peaches, but there are some where perhaps the soil is too heavy and moist for the peach. But that is the only objection. Otherwise I should prefer the greater elevation. The question is, whether or not there is a quick descent somewhere near the hill where you want to plant. A hill one hundred and fifty feet high that has a quick descent near by is preferable to a great level plain five or six hundred feet high.

Question. How many times have your trees been injured by spring frost?

Mr. Hale. Only once. The danger in New England is not from spring frost, or very rarely; it is rather from excessive freezing in the winter, when the thermometer gets down to sixteen, eighteen or twenty degrees below zero, and the ground is free from snow. People spring the question on me sometimes, "How is it that peaches are not as reliable in New England now as they were forty or fifty years ago?" I have studied that question a good deal; I have inquired of a great many people, and I judge from the answers given by old residents of New England that forty or fifty years ago they had an abundance of snow on the ground in the winter. The roots of trees therefore were kept warm. They were blanketed with two or three feet of snow, which we do not have now, but the cold is no more excessive. The trees are injured more now than formerly because the ground is bare during the cold weather. We have had the mercury at eighteen below zero in our orchard in one of the years when we had a good crop. I cannot tell the year now, but it went down eighteen degrees below zero in the least exposed portion of our orchard, and yet we had a good crop of peaches, and I believe it was because, at the time of the cold weather, there were nearly two feet of snow on the ground.

QUESTION. Have you ever tried mulching them ?

Mr. HALE. No, sir ; I never have.

QUESTION. Do you wait until the peaches are thoroughly ripe and ready to eat before you pick them ?

Mr. HALE. The aim is to let the fruit get fully matured, just thoroughly ripened, fully grown and ripe, but not mellow, and then all that is ripe is picked. Our pickers are trained to judge by the color of the fruit whether it is ripe, not by feeling of it to see whether it is mellow enough to pick. By looking on the under side they judge by the color whether it is ripe enough to pick. When the fruit is picked it is sent to the packing sheds, and there it is separated into the three grades before mentioned. In about four or five days that same tree is gone over again, and the other fruit picked from it that may have matured in that time, and again in three or four days ; so that it takes from six to ten days to get all the fruit from one tree.

Mr. CRUICKSHANKS. The question has been asked by the Secretary whether thinning apples will pay. Being a neighbor of Dr. Fisher, and somewhat familiar with his mode of treatment, perhaps I can answer that question. It will be remembered that three years ago he read a paper before this Board at Fitchburg upon orchard management. It will be remembered also that he favored the practice of thinning apples. When they got to be about one-third grown he employed a number of boys to go through his orchards, with instructions not to leave any two apples together, to remove everything that had the appearance of a worm-hole in it, and those that had worm-holes or any insects about them were all put in a basket, so that they should not fall on the ground. Those that were perfect were dropped on the ground, and he did not object to their lying there. The question naturally arose, "How much does it cost? It must cost a great deal to thin apples in that way." The doctor said, "Not so much as you think." He had over a hundred barrels of apples that year, and he said it did not cost him so much to thin them on the tree as it would to have had them picked. He stated that it cost a little over fourteen dollars to thin the fruit on trees that produced over a hundred barrels of apples. I think one gentleman has stated here that the doctor got five or six dollars a barrel for his apples.

The Chairman. I believe it has been the experience of fruit growers generally that if there is any man in the community who is to be avoided it is the nursery man or his agents. Many of them have been bitten when they have bought trees upon orders, and have had occasion to lament it. But it is an old saying that all rules have their exceptions, and perhaps there is one exception to this rule in this county. You have a nursery man here who has supplied your wants in this particular vicinity; but perhaps his excuse may be that he had other business in connection with his nursery, so that he has not been forced to resort to methods which some of the nursery men have adopted. We should be glad to hear from Mr. Draper of Worcester.

Mr. James Draper. Mr. Chairman, I thank you very sincerely for your very kind introduction. It is pleasant to hear you say that there is on the face of this whole earth even one vendor of trees who is entitled to be called fairly honest.

Now, I have been exceedingly interested in Mr. Hale's talk this afternoon, because he has treated this subject from a different stand-point from that from which we are accustomed to hear it discussed in our agricultural meetings. The questions ordinarily raised have been, "How shall we produce more?" "What shall be the culture?" "What varieties shall we plant?" neglecting the more important features of maintaining an unsullied character for putting up honest fruit, of concentrating your efforts in a few directions, and, above all, the question of the method of marketing. You have not had these subjects handled in your meetings, I think, and it seems to me you are deeply indebted to our friend from Connecticut for having brought these new elements into your discussions.

Now, experience is a good teacher. Our friend Hale has only told part of the story. Those of us who have been through his well-kept orchards, and seen the symmetry of his trees, the beauty and color of bark and bud and leaf, have said, "Is it possible that such fine peach trees can be grown in New England?" The results of 1892, which excel those of all previous years, show that he is reaping to-day the benefit of his perseverance, patience and persistency in a grand success.

I have had some experience with small fruits, and I think the first thing to strive for is to acquire a name for putting up thoroughly honest goods. That will make a market for those goods above the price of the general market. I commenced twenty-five years ago growing small fruits for the Worcester market. At that time, except the Franconia raspberries grown by Mr. Hadwen, who is the pioneer in all horticultural matters in Worcester County, there were no small fruits grown there for that market. I was satisfied that they could be grown to a profit, and I planted a field of strawberries. The result was very satisfactory. But my season was short, I had only a few weeks, and it occurred to me to supplement my strawberries with raspberries, blackberries and black-caps. So I took a journey through New Jersey, Pennsylvania, Ohio and New York State; and at that time the small fruits were first receiving public attention, and I discovered that the Philadelphia and Clark Raspberry, the Kittatinny Blackberry and Wilson's Early Blackberry were being introduced. When I returned, having had about the same experience as my friend Hale, I managed to borrow money enough to stock six or seven acres with small fruits. I was the laughing-stock of the town of Worcester. I submitted to that as gracefully as I could, as Mr. Hale has to the ridicule of the people of Glastonbury. It was very rough then, but I have gathered over three thousand dollars' worth of berries from my few acres. It was a successful business operation, and others can do the same thing.

But I want to get at this one thing. I take pride in my good name. I had a force of fifteen or twenty pickers and packers, who picked out the good honest berries, they were packed in an attractive style, and brought from five to ten cents a box above the market. It was very interesting to me on Saturday evenings, when we had two hundred and fifty or three hundred quarts of berries in the market, to take a seat back and hear people inquire for Draper's berries. It was my good name that sold those fruits.

Here is another part of the story. My boxes cost me three and a half cents apiece. The market men who handled them were also handling other fruit, and pretty soon inferior fruit came back packed in my boxes, because my name was on them. The men who brought the inferior fruit to the market knew exactly what they were doing. I only mention this in connection with what Mr. Hale has said. Pack your fruit honestly. A good name is the best capital you can have.

Then another thing. Don't spread out too thin. That is the trouble with a great many fruit growers in New England. They try to grow thirty or forty varieties of pears, to make a great spread on the tables at agricultural fairs, and carry off the premiums for the greatest number of specimens of fruit. Cut yourselves down to half a dozen, and then grow them to perfection. I would give more for a dozen fine Beurre Bosc pears than I would for a bushel of a good many other varieties. Grow the best fruits, put them up honestly, and your reputation is made in the matter of growing fruit.

Mr. McIntosh. The speaker this afternoon has stated that he had an order for some apples at from two dollars to two dollars and a half a barrel, and fifty cents a barrel less for farmers' packings. I have noticed that there has been some improvement in the method of packing apples, but there is room for a great deal more. There is nothing that spoils an apple quicker than getting a bruise on it; it does not have the natural flavor. It is not possible to have apples retain their flavor after they are bruised.

The Chairman. Will Mr. Hadwen of Worcester give us the results of his experience? I presume he has grown more fruit for home consumption, especially, than any man around Worcester.

Mr. O. B. Hadwen. I feel incapable of adding anything to what has been said this afternoon in relation to fruit growing. It is true that I have had a little experience in handling all kinds of fruit, — apples, pears, peaches and small fruits, — and I have taken a great deal of satisfaction during my farm experience in the fact that I have been able to grow fruits more or less.

In the autumn of 1843 I planted the seed that my orchard has grown from, and not only raised trees from the seed, but I budded the trees and planted them with my own hands, and have had a great many crops of apples. I regard the apple as the best fruit that God has ever given to man, and the most delicious fruit that can be used in the family the year round. My orchard comprises some twenty acres, and as a rule my apples are sold in the markets of Worcester. I find that I can get good prices for the best fruit and poor prices for the poor fruit.

In relation to peaches, I will say that the hardest work that I ever had in my farm experience was to sell my crop. That was years ago, when everybody had peaches, when they were a drug in the market and brought very low prices. I have some notions in relation to the peach tree. We all know that the peach is the most uncertain of any of the fruit crops, owing to the diseases which have attacked it. The first that was known of the yellows in this country was in 1818; I saw them first in 1842. Since then thousands of peach trees have been ruined by the ravages of the disease. The peach tree is short-lived, and it is not considered profitable to raise peaches here. It is true that by feeding a peach tree with stimulating materials, as Mr. Hale does, we may prolong its life, and perhaps it may be profitable for a period. But the question comes, What is the reason that we have this disease which has come upon us? I believe that peach trees grown from the stones taken from trees that are healthy, will be longer-lived and more satisfactory than trees that are nursery-grown from stones coming from diseased trees, or budded, perhaps, from trees raised from stones that come from diseased trees, and consequently they are short-lived and not satisfactory.

Mr. Hale has said that an apple should be well fed, and fed every year. That was a good point that he made. An apple tree should be fed every year, the same as we feed our other crops, in order to produce the best results; and not only apple trees, but all trees, even ornamental trees, will not produce the same results if they are neglected in this respect that they will if bountifully fed. We see a demonstration of that on Mr. Hunnewell's grounds in Wellesley.

His ornamental trees, his coniferæ and his deciduous trees, are bountifully fed. You cannot find such foliage anywhere else. In order to produce good fruit of any kind, you must be liberal in your application of manure.

QUESTION. I would like to ask Mr. Hale if his peach trees have been affected with the yellows, and, if so, what he does to them or with them?

Mr. HALE. We occasionally have a case of yellows, but we have had but little of it. Where we have put on a liberal supply of fertilizers, such as I have indicated, we have found but few traces of the yellows. Wherever we have had it of late years, — perhaps largely out of respect to the opinion of others, rather than our own belief, — we have pulled the trees up and cast them into the fire. Some years ago, instead of pulling them up at once, we pruned them more severely than ever, increased the quantity of potash, and stimulated a quick, new growth of the trees by giving an abundance of nitrate of soda to those that prematurely ripened their fruit or had any other trace of yellows. Those trees have since borne good crops, lived a few years, but finally died. Now we dig up trees that are attacked with the yellows, and burn them at once.

Professor ROBERTS. What per cent of your trees have been attacked by the yellows?

Mr. HALE. About five per cent.

Professor ROBERTS. In the peach district of Michigan, since they have adopted the heroic treatment, they find that they can easily keep the yellows down to two per cent of the trees, if they take out the trees which are affected quickly.

Mr. HALE. To show how the disease spreads, I will state that two years ago I saw one tree in our orchard that had indications of the yellows. That tree was pulled out. None of the trees around it were apparently affected. Last year the trees all about it — that is, the four adjoining trees to where that one had been pulled out — showed the yellows, and we pulled those four diseased trees out, and then we pulled out some ten or twelve more. I think there were eighteen trees taken out in all. This year there were still traces of the yellows right around the border where those trees grew, and we have taken out forty trees. That is the worst attack of the yellows we have ever had.

Professor ROBERTS. I will add to my statement that the law of Michigan makes it incumbent upon a man to take out his diseased trees. If he does not take them out, the commissioner takes them out and takes a good slice out of his bank account for neglecting his duty.

Mr. HALE. Michigan has a most efficient law in that respect, and it is working well. There was a similar law passed in the State of New York against the yellows and the black-knot; but the weak point in all these laws seems to me to be that commissioners are only appointed upon the call of a certain number of interested fruit growers. Now, the very men who need protection against these diseases have not pluck enough or progress enough to ask for the appointment of such commissioners. Progressive fruit growers will look out for the yellows and the black-knot; but there are a great many men who will not look out for themselves, and those men the law must look after. Commissioners should be appointed for every township, whether the fruit growers ask for such appointment or not.

QUESTION. Did you set new trees where those died of the yellows?

Mr. HALE. We have not done it in our older orchards, but I would not hesitate to do it from any fear of the disease. We have a new orchard where a number of the trees have died of the yellows, and we have pulled them up and put new trees in the places of those that were taken out. There is no trouble about it. I would not hesitate to put another tree right in where a tree affected by the yellows has been taken out. I have never yet seen any ill effects follow from it.

QUESTION. If you were going to plant a peach orchard on a hill, which side of the hill would you select?

Mr. HALE. I should not want to answer that question off-hand. I do not know anything about the character of the soil. But, so far as hills are concerned, I should rather prefer the north side of them. It depends upon the character of the soil. That may be too wet.

QUESTION. Would you have a wind protector?

Mr. HALE. I should not care anything about that. In our few years' experience in Connecticut we have never seen any ill effects from exposure. But I can conceive that there might be a time when the mercury sank to ten or twelve degrees below zero, and a north-west gale came that lasted two or three days, when a wind protector would be of value.

QUESTION. How late do you cultivate your orchard, and is there not danger of cultivating it too late?

Mr. HALE. Oh, yes. That is a good question. We seldom care to cultivate after the middle of July, but occasionally do finish up the last week in July. But we never want to lap over into August, on any account.

Professor ROBERTS. I rather got the impression, from the drift of the discussion this forenoon, that there are a good many men in this audience who believe that they can buy cattle food cheaper than they can raise it here in Massachusetts. I believe there are a good many such men in New York. I think we are carrying that idea a little too far. I understand from your remarks that you believe that people had better raise their fruit rather than buy it of other parties. Am I right?

Mr. HALE. Of course.

Professor ROBERTS. And they can raise fruit cheaper than they can buy it of you?

Mr. HALE. Yes. I expect a profit of at least one per cent, and if you buy packages with the red labels upon them you pay two or three per cent.

Mr. VINCENT. I live in Conway, in the western part of the State. I have been engaged somewhat for the last two or three years in raising plums, and so far I am rather pleased with it. I have a Japanese variety which seems to promise well. I would like to know if you have any fruits in the plum line, and whether they are subject to the black-knot? I have never seen any symptoms of the disease on that tree, and I have had it five years.

QUESTION. What is it?

Mr. VINCENT. It is called the Botan. There are several varieties of the Botan. I have been very much pleased with it.

Mr. HALE. I am glad the gentleman has brought that question up. Two or three varieties of the Japanese plums have been introduced within the past ten years, and promise to be very valuable in southern New England. It is a little questionable whether they will do well in the more northern sections, as the wood is somewhat tender. It has been a little injured in Connecticut once or twice, but not seriously. Where the wood of those plums will stand our climate, I believe they will prove to be the most profitable and reliable plums that we have. The yellow Botan had the name Abundance given to it simply to make it sell better. That was a trick of the nursery trade, not legitimate by any means, but it has got that name attached to it, and probably it will keep the name Abundance. The Satsuma, which is a red-fleshed plum all through, solid and meaty, with a very small pit, and the Burbank, introduced into this country by Luther Burbank of Santa Rosa, Cal., give very good promise of being of great value. They have not, as far as I know, anywhere in New England developed the black-knot, and they seem to be less susceptible to attack by the curculio. But now we have learned how to get rid of the curculio by spraying, so we do not care very much for that.

QUESTION. Do you find that there is a liability of these varieties of plums blooming so early that the spring frost will injure them?

Mr. VINCENT. I have noticed that they bloom earlier than the Green Gage.

Mr. HALE. If there is any doubt about the permanency of these fruits here in New England, it may be that they will bloom a little early, and occasionally suffer somewhat from spring frost.

Mr. VINCENT. I set out a hundred trees last spring, and think I shall set another hundred next spring. They made a rapid growth, and have done very well.

Mr. W. H. BOWKER (of Boston). This section around here is the best dairy section in Massachusetts. The rich land is all on the top of these beautifully rounded hills. I happen to have a farm on one of these hills, not more than twelve miles from here. I have an apple orchard on it, and the ground is so rich that I am getting poor fruit. It is so rich that it produces a large amount of wood, so that I cannot get it properly thinned out. I have three men, and not one has had courage enough to trim those trees as they should be trimmed, so that the fruit is actually smaller than it used to be on the farm where I was raised, ten miles further north, where the soil was poor and gravelly. Now, I believe that if you should put fifteen hundred pounds of ground bone and five hundred pounds of potash on that apple orchard, you would not raise any apples worth eating unless you cut the trees pretty nearly down.

Mr. Hale. I was talking about *peach* trees, and then perhaps I was not buying as highly concentrated fertilizers as Mr. Bowker would sell.

Mr. Bowker. That is another thing, for it is the pit of the peach, of course, that is exhaustive. The seed of the apple is not anywhere near as exhaustive as the stone of the peach. The practical question in this particular section is, How much fertilizer should be applied to an apple orchard?

Mr. Hale. As I said at the outset, the soil here is good enough; I do not want any better soil. If I were to set out a peach orchard here, I would put on some sections twice as much fertilizer as on others, but I would not overdo it. If I had an apple orchard like yours, which was evidently growing too fast, it would show that there was too much nitrogen there. Perhaps a little potash might help it. The way to bring your orchard into bearing is to trim the tops of the trees a little, and root-prune them a good deal. A little incident in that line may be of interest to you. On my home farm there is a piece of land near the houses which is strong, rich, loamy soil. There are two apple trees growing there, and the fruit is just about the same as that which you have described. I guess we could put the apples into the same barrel, and nobody would distinguish the difference. We wanted to drain a piece of low, swampy land near those trees, and we went within six feet of one tree and about ten feet of the other, and dug down about twelve feet, and we cut off every root of those trees on that side. That root-pruning just stimulated the trees into bearing. They have done nobly ever since.

Mr. Bowker. That is just what I wanted to bring out, because I have that very difficulty. I know that the ground is rich enough, and I have not been able to find out why the fruit was not better.

You have spoken of another point, and that is with reference to frost running down hill. That is your experience, but is that backed up by science?

Mr. Hale. I am not a scientist, nor the son of a scientist.

Mr. Bowker. That is a very interesting question, for, if we know that frost is going down hill right away from elevated locations, those are just the places where we want to grow certain crops.

Mr. Hale. I do not mean that the frost is all going away, so that you can grow peaches on top of a hill as you can grow potatoes at the foot; but I mean that it makes a more even temperature. It is cooler in summer up there and warmer in winter.

Mr. Bowker We know that as we pass down through a valley there is a cold stratum of atmosphere, and as we go up the temperature becomes warmer.

Now another point. You said that our winters are less severe than they were fifty years ago; that is, there is less snow now than formerly?

Mr. Hale. Yes, sir.

Mr. Bowker. What is the record, Professor Goessmann?

Professor Goessmann. Professor Snell of Amherst College, who has weather records for fifty years, says that, taking the average temperature of the winter months for twenty-five years, there is not a difference of half a degree.

Mr. Hale. Has he a record as to the fall of snow?

Professor Goessmann. No, sir.

Mr. Hale. The statement that I made was as to the average temperature, comparing the last ten years with fifty years ago. I take it for granted that it is as I stated it, from the observations of practical men. We do not have any colder weather now than we had then, but in olden times they had deeper snows, and the snow carpeted the roots of the trees.

Mr. McIntosh. I can remember back more than fifty years, and I know that fifty years ago it was a rare thing not to see snow on the ground from about Thanksgiving time until the first of April.

Mr. Bowker. I think the rainfall has not varied materially for twenty-five or forty or fifty years. The snowfall may have varied.

Mr. Fenn (of Milford, Conn.). I can remember seeing snow-banks twenty-five years ago that were as high as the fences, and they remained from the first of December until the first of March and even later. We do not have so much snow now. The cold may not be so severe now, but we have greater extremes, — very warm spells and very cold spells, — and I think they do more injury to the peach than anything else.

Mr. Hale. There is no doubt that sometimes the peach buds have been killed in New England in the last dozen or fifteen years by a moderate fall of temperature, perhaps ten degrees below zero, that would not have killed them if they had not been swollen somewhat by the warmer weather preceding. There is no doubt there is something in that.

Mr. Fenn. Our cold weather does not commence so early as it used to, and consequently the buds have a chance to swell a little before cold weather comes, which makes them more tender.

Mr. ——. The speaker referred to feeding peach trees with clover, but he did not say whether he sowed it or allowed it to be fed over.

Mr. Hale. We sow it at the time of the last cultivation in July, and plough it under the next spring.

Question. Would you thin plums as much as peaches?

Mr. Hale. More so. They are liable to rot if they come in contact with each other.

Question. What has become of the Excelsior or Crosby peach?

Mr. Hale. It is alive now, and will be growing in the spring.

Question. Why did you not mention it?

Mr. Hale. The reason I did not was because I never like to mention anything in a public address that I have any financial interest in the sale of, as I have in the Crosby peach trees.

Adjourned to evening.

Evening Session.

The meeting was called to order at eight o'clock by the Secretary, who said: —

I take great pleasure in being able to announce to you that Mr. William H. Bowker, a graduate of the Massachusetts Agricultural College, will preside this evening. Mr. Bowker was a member of the first class graduated, and it seems to be quite fitting that he should preside over a meeting which is to be addressed by his old teacher, Professor Goodell, who has been a teacher at the College from the start.

Mr. Bowker. It gives me great pleasure to come here this evening and introduce my old teacher to you. If you knew him as I have known him, almost from boyhood, — for he was a boy when he taught me, — you would know that the gentleman who is to address you to-night is one who has been loyal to the cause of education wherever he has taken it up, whether in his first school at Easthampton or in the larger school at Amherst; he has been loyal to the cause of industrial education, and always ready to defend it at all times and under all circumstances. I have had very interesting conversations with him about this lecture which he is to deliver to you this evening, and, if he tells you some of the interesting stories that he has told me with reference to his experience in buying cattle, and what took place when he bought them, I know you will be very much entertained as well as interested.

I have the pleasure, ladies and gentlemen, of presenting to you President Goodell, who will speak to you on "The Channel Islands and their Agriculture."

President Goodell. Mr. Chairman, ladies and gentlemen, I am very glad that Mr. Bowker has told you, in the first place, that I was a mere boy when I instructed him, otherwise I am afraid you would consider me an old man. I do not propose to be an old man, although this year completes the quarter-century of service that I have given to the Massachusetts Agricultural College.

THE CHANNEL ISLANDS AND THEIR AGRICULTURE.

BY HENRY H. GOODELL, LL.D., AMHERST.

The subject assigned me to-night is the Channel Islands and their agriculture. There is no more interesting spot on the face of the globe, and none that displays sharper contrasts. Geographically belonging to France, territorially they form an outlying dependency of the British crown. Apparently most barren and unfertile of soil, they yield crops rivalling in richness those of the virgin plains of our own great West. Rent and torn by the waves that rush in upon them from the Atlantic, lashed by the refluent surge from the coast of France, and swept by the boiling tides that under favoring circumstances rise to a height of over forty feet, they find in the floating sea wrack of the very waves which threaten their existence the chief element of their fertility. Lying at the very entrance of the English Channel, just where it broadens out and loses itself in the immensity of the ocean, and exposed to every wind that blows, they yet enjoy a climate so equable and mild that the flowers of the tropics bloom there the year round in the open air.

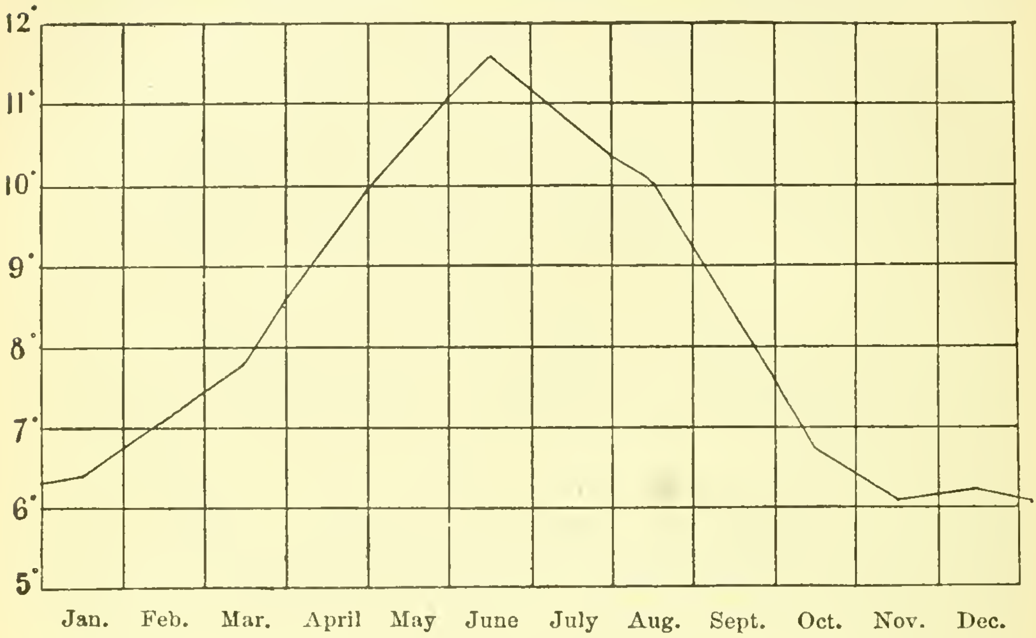
No less remarkable in their characteristics are the people. Calling themselves Englishmen, they yet speak a *patois* of French impossible to be understood by any one not native born, and compel its use in school and court. Blindly adherent to ancient law and custom, they have made themselves known the world over for the advanced position they have taken on all matters pertaining to agriculture. Jealously resisting every encroachment upon their liberties, and so independent that all laws affecting them have first to be passed upon and approved by their own *States* before becoming valid, they yet are the most loyal of subjects and tenacious in their support of the crown. The last of the great

French possessions united to England when William the Conqueror crossed the Channel and overthrew the Saxon dynasty, they have remained through all these years unshaken in their fidelity to the representatives of their hereditary sovereigns. Race, language, contiguity of territory, would seem to have allied them to Norman France; yet so slight was the bond that held them, that shortly after the separation we find this added petition in their litany: "From the fury of the Norman, good Lord deliver us." Undoubtedly in bygone ages, before subsidence had taken place, these islands formed a part of the continent, and were actually joined to France; but now they stand like sentinels, lone outposts, surrounded by rushing tides and raging seas, which in their ceaseless action have eaten out and swept away the softer and more friable rocks, leaving only a "fretwork of those harder barriers that still resist attack, and are enabled to present a bold and serried front against their relentless enemy."

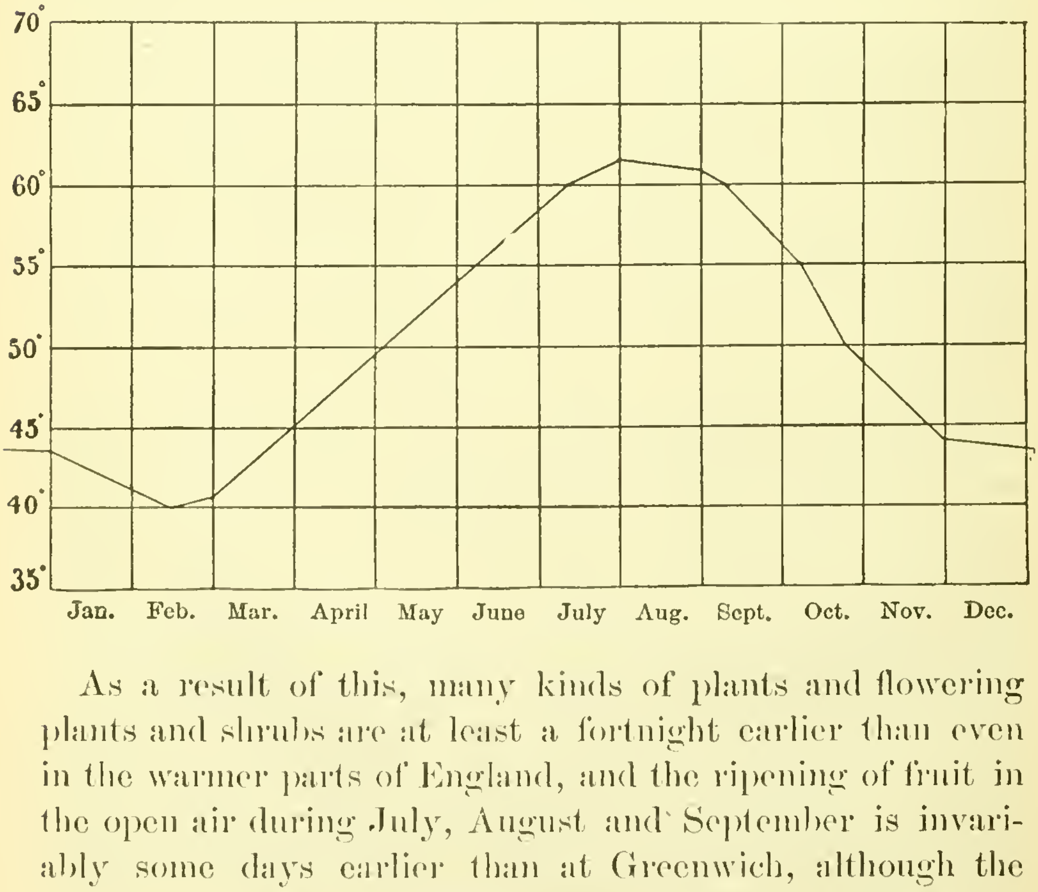
The Channel Islands are six in number, namely, Jersey, Guernsey, Alderney, Sark, Jethou and Herm, and lie one hundred miles south of England and fifteen from the shores of France, being well within a line drawn parallel to the coast, from the end of the peninsula on which Cherbourg is built. The two largest of these — Jersey and Guernsey — are the ones with which we shall concern ourselves to-night. Small in area, mere dots on the surface of the globe, they yet have won for themselves a name and place in the agriculture of every civilized nation of the world. The first, some eleven miles in length by five and a half in breadth, covers an area of 28,717 acres; the second, nine and a half miles in length by six and a half in breadth, contains about 19,705 acres. Of these areas scarce two-thirds is land that can be cultivated, for we must bear in mind that the formation is mostly granite, rising in cliffs from two hundred to four hundred feet, with deep indentations and wide encircling bays where the sea has eaten into the shore. From the elevated crest to the water's edge is a "wide margin of descent, upon which fertile soil cannot accumulate, and a poor and scanty pasturage, its only possible produce, is generally more or less overpowered by brake, gorse and heath."

As you approach the Jersey coast nothing more picturesque can be well imagined. Ten miles of granite cliff stretching along its northern exposure two hundred and forty to four hundred and eighty-five feet in height, while on the south eight miles of similar formation rise from two hundred to two hundred and fifty feet, and against this the waters madly foam and break and dash their spray far up the sides, rending and rifting them in every possible manner, or wearing out dark chasms and overhanging arches. There results from this formation a general slope and exposure to the south very favorable to vegetation. Furthermore, the whole island is intersected from north to south by a succession of ravines or valleys, gradually widening and increasing in depth, and forming a natural channel for the small streams taking their origin in the springs which everywhere abound. It has been said that the three primary elements necessary to the success of agricultural operations are skilful husbandry, a well-constituted soil and a genial climate. All three of these requisites Jersey possesses in the highest degree. Though resting on a bed of primary rocks of granite, syenite and schist absolutely wanting in organic remains, yet the soil is a rich loam, varying in lightness with the character of the underlying stratum. Even in the bays, where the sand driven by the winds has encroached upon the soil, the land is so successfully tilled, that St. Clements Bay has won for itself the title of the "Garden of Jersey." The climate is one of the most equable and mild in the world. Rarely does it fall below the freezing point, and there is but one instance on record of its reaching 83°. The ground seldom freezes more than an inch or two, and the slight snows serve to keep off the frost altogether. Winter there is none, but the spring is usually cool and late. The mean daily range of the thermometer is exceptionally small. Taking the average of ten years, it is found to be but 8.1°. The days of summer are not very hot, but the nights are comparatively warm, and there is hardly any chill in the night air at any season of the year. There is no recorded climate, and probably no climate whatever in north temperate latitudes, on either side of the Atlantic, that presents so small a daily range of the thermometer. Such is the opinion of an enthusiastic traveller.

Mean Daily Range of Each Month from an Average of Ten Years.



Mean Temperature of Six Years at Jersey during Each Month of the Year.



As a result of this, many kinds of plants and flowering plants and shrubs are at least a fortnight earlier than even in the warmer parts of England, and the ripening of fruit in the open air during July, August and September is invariably some days earlier than at Greenwich, although the summer is cooler than at that place. Another striking peculiarity which doubtless has its effect upon vegetation is the rainfall. Taking the average of six years, rain is found to fall on one hundred and fifty days, but it most frequently occurs at night or early in the morning, seldom lasting through the day, thereby securing the maximum of sunshine. The mean annual rainfall is about thirty-three inches. Under these favorable conditions of temperature and moisture a flora that is almost tropical prevails. Fuchsias reaching the proportions of shrubs, rhododendrons twenty to twenty-five feet in height, araucarias, or monkey trees, as they are popularly designated, oleanders, yuccas, palms, azaleas and camellias flourish in the open air, while climate and soil appear to be particularly suitable for the cultivation of the dahlia. Finer specimens I have never seen. The laurestinus was in bloom in November, and fig trees and oranges were everywhere to be seen trained against the south walls of enclosures. It is a climatic law that in all places where the mean temperature is below 62.6°, the revival of nature in spring takes place in that month of which the mean temperature reaches 42.8°. On the island of Jersey this occurs in February. This again is a very important factor in the agricultural development of the place, for the early spring and the proximity of the great markets of London and Paris enable the inhabitants to dispose of their produce at a great profit. It is no uncommon thing for a man to pay for a piece of potato land as high a rental as two to three hundred dollars an acre, and sell his crop of four or five hundred bushels for $1,000 or $1,100. But this is not the end, for immediately after the gathering of the first crop the land is freshly manured and a second crop is planted, yielding from two-thirds to three-fourths the amount of the first. These results can only be secured by the application of large quantities of manure. Barn-yard manure and also artificial fertilizers are used; but the main dependence is placed upon the vraic or sea-weed. The old legend runs: "No vraic, no corn; no corn, no cows; no cows, no bread for children's mouths." This is either washed ashore by the action of the waves, or, at the period of maturity, is separated by bill hooks or sickles fastened on to long poles and drawn in by rakes with a head two or three feet wide and handles twelve to twenty feet long. The cutting and gathering of the vraic is a general holiday, terminating usually in a frolic. It is only allowed twice a year: once in February, beginning with the first new or full moon and lasting five weeks; and again in June, beginning in the middle of the month and closing on the 31st of August. Whole families will frequently unite, and, going to some spot previously selected, work hard all day, the men standing up to their waists in water, using their unwieldy sickles and rakes, and the women and children dragging the prize up beyond the reach of the tide. With the coming of night the sea-weed is removed in carts, and then all hands, meeting at the house of some one of their number, spend the hours in dancing and singing. During the first four weeks of the summer cutting, only the poor, or those having no cattle, are allowed to gather this harvest of the sea. That cast up by the waves may be taken at all seasons by any person between the hours of sunrise and eight o'clock at night. About sixty thousand loads are gathered annually, valued for manurial purposes at about fifty cents per load. It is applied either fresh at the rate of ten loads to the acre, or in the form of ashes obtained by burning it, a load yielding about three bushels of ash. There are two species of this vraic, the Fucus and the Laminaria, and the following analyses will give an idea of their value: —

ANALYSES OF VRAIC.

	Laminaria digitata. (Per Cent.)	Fucus vesiculosus. (Per Cent.)
Water in the undried weed,	82.00	71.00
Dry Weed.		
Organic matter, per cent,	70.11	80.36
Soluble ash,	23.56	14.08
Insoluble ash,	6.33	5.56
	100.00	100.00
Composition of Soluble Ash.		
Sulphuric acid,	2.13	4.17
Chlorides of potash and sodium,	21.53	11.40
Potash,	6.89	2.04
Iodine,	0.48	0.01

The drift weed belongs to the Laminaria, of which there are two varieties, and the cut weed to the Fucus, of which there are three. The latter is considered the more valuable, perhaps from its containing a larger per cent of organic matter.

The population of Jersey, according to the last census, is a little over 65,000. The area of the island is as already stated, — 28,717 acres. Of this, only 19,514 are under cultivation, so that practically three persons are supported to each acre. It may not be uninteresting to note the acreage of the different crops, and compare it with the amount of produce exported. In 1891, the corn crops (wheat, barley, oats, rye, beans and peas) occupied 2,199 acres, wheat leading with 1,700; green crops, including potatoes, turnips, mangolds, cabbages and vetches, were 7,816, potatoes leading with 7,000; clover and grasses under rotation, 5,247; permanent pasture, 4,053; flax, 3; small fruits, 158; and uncropped arable land, 38. Horses numbered 2,360; cattle, 12,073; sheep, 305; and pigs, 7,618. In that same year there was exported into England alone, 2,300 cows and calves, or a little over one-sixth the entire number; 25 tons of butter; 1,863,165 bushels of potatoes, an average of 266 bushels to every acre under cultivation; 86,000 dozen eggs; 74,969 bushels of fruit and vegetables, to the value of $400,000; the whole footing up to the snug little income of $3,700,000, to be distributed among the 2,600 farmers owning or cultivating land. It is a noticeable fact that, while the cattle were valued at £40,000, the potatoes were placed at £447,134, or eleven times that sum. The figures above given are equally applicable to Guernsey, except that there a greater amount of fruit is grown, the yearly export of grapes footing up to over 500 tons. Tomatoes are raised in immense quantities for the London market, but no reliable statistics were available. As compared with our best varieties, they are very inferior in size and quality. The vines are trained up against the sides of the house, and continue bearing sometimes more than one year. The principal fruits are grapes, apples and pears. Jersey cider was at one time so celebrated that the agricultural society of the department of the lower Seine in

France sent over a commission to learn the methods of its manufacture; but the apple trees are now giving way to the potato, though still 30,000 to 40,000 bushels of the fruit are exported annually. Climate and soil seem especially adapted to the cultivation of pears, of which there are some fifty varieties grown, *bergamottes*, *doyennes*, *beurrés*, etc. But the most remarkable are the chaumontel, whose fruit frequently reaches proportions that are truly wonderful. For fear you should think I am drawing on my imagination, permit me to quote from official records: —

"These pears are usually plucked about the 10th of October, but are not fit for use for several weeks, being in perfection about Christmas. Those weighing sixteen ounces are regarded as first rate, and fetch good prices. Pears of this size average in value twenty-five to thirty dollars per hundred in the island markets; but as they diminish in size and weight the value falls rapidly, the numerous small fruit being considered only fit for baking, although in point of flavor they are little inferior. The largest and best grown fruit on record was raised at Laporte in Guernsey in 1849. It measured six and one-half inches in length, fourteen and one-half in girth, and weighed thirty-eight ounces. As a group of pears from a single tree, there is perhaps no more remarkable instance recorded than one occurring in the season of 1861, when, of five fruit obtained from one tree in the garden of Mr. Marquand of Bailiff's Cross, Guernsey, four of them weighed together seven and one-half pounds. It is worthy of remark that in this case the tree, though usually prolific, bore only these five fruit. The pears in question weighed respectively thirty-two and one-half, thirty-three, thirty-one and one-half and twenty-two ounces."

Equally remarkable among the vegetables are the great cow cabbages. They reach a height of eight to ten feet. I myself measured one that was over eleven, and at the agricultural rooms at St. Helier there is preserved the record of one whose stalk measured sixteen. It takes a year for these plants to mature. They are set in November or December, about two feet apart, and grow all through the following season. The ground is hoed up against them when they have reached a certain height, having been previously enriched with sea-weed. The leaves are stripped off as they become large, being used either for feeding cattle or packing butter, and the plants are left to spindle up with a small crown at the top. The stalks, which occasionally take on tree-like dimensions, are used as palisades for fences or poles for beans, but most frequently they are shellacked over or varnished and made into canes, selling readily to tourists at prices ranging from fifty cents to a couple of dollars.

From what has been said it will be readily conjectured that the potato is the chief crop. The greatest care is taken in the selection of seed, and they are handled as tenderly as the choicest fruit, each tuber being picked up separately and placed in an open crate, only one layer deep. In some sheltered spot or in a shed these crates are piled up one above the other till ready for use. When preparing for planting, these are placed in some warm corner and the potatoes allowed to sprout, selection being made of those shoots which have formed a healthy top and spring from a good eye. About twenty-two hundred-weight of seed per acre is used, being set about ten inches apart, and in rows some twenty-two or three inches wide. Cultivated in the open air, they are ready for market in April and May, but with the glass-house system now in vogue they are matured much earlier. Previous to the inroads of the potato disease, which greatly affected the crops, it was no uncommon thing to have a yield of twenty tons to the acre, and the average was fourteen; but it has now dropped to ten or eleven. So great is the demand for these potatoes that few are retained for home use, and large quantities are imported from France into Jersey for consumption; but, owing to the early crop being exported at a very high price, and the French potatoes purchased when the price is lowest, the balance of profit remains very largely in favor of the island.

Some idea of the fertility of the soil may be formed from the following figures: Hay averages three and one-half tons to the acre; a good return of one-year-old clover is over four tons, of two-year-old not more than three and one-quarter; wheat averages thirty-five bushels, though in some favored fields the yield has reached sixty; mangolds fifty tons, occasionally reaching seventy; parsnips twenty-five to thirty;

and carrots thirty. Wheat is sown in January, and that is followed by parsnips and potatoes; oats in February and mangolds in April. The rotation of crops is a five-year one, namely, turnips, potatoes, wheat, hay, hay. The grass is top-dressed in January or February with sea-weed, and that is followed later in the season by an application of liquid manure. Everything is turned to getting the most possible out of the land; and a recent writer, with just a touch of sarcasm, remarks: "Jersey still remains a land of open-field culture, and yet its inhabitants, who happily have not known the blessings of Roman law and landlordism, and still live under the common law of Normandy, obtain from their land twice as much as the best farmers of England. Besides their potatoes, they grow plenty of cereals and grass for cattle; they have more than one cow to each acre of meadows and fields under grass; they export every year, besides a large amount of dairy products, some 2,300 milch cows; and, on the whole, obtain agricultural produce to the amount of $750 to each acre of the surface of the island."

So much has been said and written of late years respecting the cattle of Jersey that it would seem almost unnecessary to make mention of them. A few facts, however, in regard to their management and care, may not be uninteresting. In round numbers, twelve thousand are scattered over the island, but nowhere are large herds to be seen. Bunches of two or three, at most five or six, are found on the different farms, rarely more. This is easily accounted for by the small holdings of the farmers, the 19,000 acres of arable land being distributed among 2,600 owners. Of the entire number, according to the returns of 1891, 6,700 were cows and heifers in milk or in calf, 668 were two years and over, and 4,600 were under two years. Cows are considered in their prime at six and continue good until ten. After that they deteriorate rapidly. The first calf is usually dropped when the animal is two or under, and this has been offered as a reason for the small size of the breed. Cattle are allowed to remain out from May to October. After that they are housed at night, being driven in at four and let out at nine the following day. They are fed morning and evening, their ration being the same, three-fourths bushel of roots and a little hay, and are milked three times a day during the summer. When out at pasture they are never allowed to roam, but are close tethered by a rope about four yards in length. Three times a day the stake to which the tether is attached is moved eighteen inches on a line parallel to the side of the field. In this manner the most economical use is made of the pasturage, and every blade of grass is cropped close. The whole care of the cattle devolves upon the women, who make great pets of them. As a result, they become singularly gentle and docile.

Since 1789, when a very stringent law was passed, the breed has been kept absolutely pure, a fine of one thousand dollars being imposed for every head of foreign cattle introduced, besides confiscation of cattle and boat, the cattle confiscated being killed on the spot, and the meat distributed or sold for the benefit of the poor of the parish where it shall be seized. In addition to the above heavy fine imposed on the captain, each sailor was liable to a fine of two hundred and fifty dollars, or in lieu thereof to six months' imprisonment. Up to 1833 no one had thought of improving the breed by any system or fixed rule, but on the formation of the Royal Jersey Agricultural Society, a scale of points for judging cattle was adopted, premiums were offered and the following regulations laid down: "Any person withholding from the public the service of a prize bull shall forfeit the premiums; and all heifers having had premiums adjudged them shall be kept on the island until they have dropped the first calf." These efforts and the increasing demand for the stock have led to the improvement of the breed in certain definite directions. The following scale of points has been adopted by the society: —

Ratio Scale of Points for Bulls.

Articles.		Points.
1.	Registered pedigree,	5
2.	Head fine and tapering, forehead broad,	5
3.	Cheek small,	2
4.	Throat clean,	4
5.	Muzzle dark, encircled by light color, with nostrils high and open,	4
6.	Horns small, not thick at the base, crumpled, yellow, tipped with black,	5

Articles.		Points.
7.	Ears small and thin, and of a deep orange color within,	5
8.	Eyes full and lively,	4
9.	Neck arched, powerful, but not coarse and heavy,	5
10.	Withers fine, shoulders flat and sloping, chest broad and deep,	4
11.	Barrel hooped, broad, deep, and well ribbed up,	5
12	Back straight from the withers to the setting on of the tail,	5
13.	Back broad across the loins,	3
14.	Hips wide apart and fine in the bone,	3
15.	Rump long, broad and level,	3
16.	Tail fine, reaching the hocks, and hanging at right angles with the back,	3
17.	Hide thin and mellow, covered with fine, soft hair,	4
18.	Hide of a yellow color,	4
19.	Legs short, straight and fine, with small hoofs,	4
20.	Arms full and swelling above the knees,	3
21.	Hind quarters from the hock to point of rump long, wide apart, and well filled up,	3
22.	Hind legs squarely placed when viewed from behind, and not to cross or sweep in walking,	3
23.	Nipples to be squarely placed and wide apart,	5
24.	Growth,	4
25.	General appearance,	5
	Perfection,	100

No prize to be awarded to bulls having less than 80 points. Bulls having obtained 75 points shall be allowed to be branded.

Ratio Scale of Points for Cows and Heifers.

Articles.		Points.
1.	Registered pedigree,	5
2.	Head small, fine and tapering,	3
3.	Cheek small, throat clean,	4
4.	Muzzle dark, and encircled by a light color, with nostrils high and open,	4
5.	Horns small, not thick at the base, crumpled, yellow, tipped with black,	5
6.	Ears small and thin, and of a deep orange color within,	5
7.	Eye full and placid,	3
8.	Neck straight, fine, and lightly placed on the shoulders,	3
9.	Withers fine, shoulders flat and sloping, chest broad and deep,	4
10.	Barrel hooped, broad and deep, being well ribbed up,	5
11.	Back straight from the withers to the setting on of the tail,	5
12.	Back broad across the loins,	3
13.	Hips wide apart and fine in the bone; rump long, broad and level,	5

Articles.		Points.
14.	Tail fine, reaching the hocks, and hanging at right angles with the back,	3
15.	Hide thin and mellow, covered with fine, soft hair,	4
16.	Hide of a yellow color,	4
17.	Legs short, straight and fine, with small hoofs,	3
18.	Arms full and swelling above the knees,	3
19.	Hind quarters from the hock to point of rump long, wide apart and well filled up,	3
20.	Hind legs squarely placed when viewed from behind, and not to cross or sweep in walking,	3
21.	Udder large, not fleshy, running well forward, in line with the belly, and well up behind,	5
22.	Teats moderately large, yellow, of equal size, wide apart and squarely placed,	5
23.	Milk veins about the udder and abdomen prominent,	4
24.	Growth,	4
25.	General appearance,	5
	Perfection,	100

No prize shall be awarded to cows having less than 80 points.

No prize shall be awarded to heifers having less than 70 points.

Articles 21 and 23 shall be deducted from the number required for perfection in heifers, as their udder and milk veins cannot be fully developed.

We have thus far dealt only with open-air cultivation, but there is another phase, still more interesting, in which everything is grown under cover. Until the glass-houses of Jersey and Guernsey have been visited, no one can fairly appreciate the possibilities of intensive gardening. Originally erected for the purpose of growing grapes, they now combine that with the raising of all crops grown in the open air. These glass shelters are of the simplest construction, in most cases mere frames of glass and wood, sometimes heated, but oftener not. But they yield enormously, crop after crop, throughout the entire season. Hardly is one out of the way than another takes its place. Before the potatoes are out of the ground, beet or broccoli is set between the rows, etc. The whole island of Guernsey is dotted with them; here mere lean-tos against the sides of the buildings, there more substantial structures in the fields, or again rising tier upon tier up the steep hillsides. The grape crop, of which the annual exportation from the island of Guernsey is over five hundred tons, valued at some two hundred thousand dollars, and on which the inhabitants chiefly relied for an income, has now become a side issue, and is entirely eclipsed by the immense quantities of potatoes, tomatoes, peas, beans and carrots raised under these shelters. It was not my good fortune to visit these glass-houses in the early season; but in November, on the island of Jersey, at Goose Green, in a house some nine hundred feet long by forty-one or two broad, I saw them ploughing down the centre while they gathered tomatoes from the vines on either hand, and picked the pendant bunches of grapes from the trellis work on the sides. No more interesting description of the vegetable houses has been written than that by Prince Kropotkin, and you will, I am sure, bear with me for a few moments if I quote from his recent article on the "Possibilities of Agriculture." "I saw three-fourths of an acre, covered with glass and heated for three months in the spring, yielding about eight tons of tomatoes and about two hundred pounds of beans as a first crop in April and May, to be followed by two crops more during the summer and autumn. Here one gardener was employed, with two assistants; a small amount of coke was consumed; and there was a gas engine for watering purposes, consuming one dollar's worth of gas every month. I saw again, in cool greenhouses, pea plants covering the walls for the length of a quarter of a mile, which already had yielded by the end of April thirty-two hundred pounds of exquisite peas, and were yet as full of pods as if not one had been taken away. I saw potatoes dug from the soil in April to the amount of five bushels to the twenty-one feet square, and so on. And yet, all that is eclipsed by the immense vineries of Mr. Bashford in Jersey. They cover thirteen acres, and from the outside these huge glass-houses and chimneys look like a factory. But when you enter one of the houses, nine hundred feet long and forty-six feet wide, and your eye scans that world of green embellished by the reddening grapes or tomatoes, you forget the ugliness of the outside view. As to the results, I cannot better characterize them than by quoting what Mr. W. Bear, the well-known writer upon English agriculture, wrote after a visit to the same establishment; namely, that the money returns from these thirteen acres 'greatly exceed those of an ordinary English farm of thirteen hundred acres.' The last year's crops were twenty-five tons of grapes (which are cut from May till October, ranging in price at wholesale from one dollar a pound to eighteen cents), eighty tons of tomatoes, thirty tons of potatoes, six tons of peas, and two tons of beans, to say nothing of other subsidiary crops. On seeing such results one might imagine that all this must cost a formidable amount of money; but not so. The cost of Mr. Bashford's houses, most excellently well built, is only $2.34 per square yard (heating pipes not taken into account); and all the work is done by thirty-six men only; three men to each acre of greenhouses seems to be a Guernsey average. As for fuel, the consumption amounts to no more than one thousand cart loads of coke and coal. Besides, one can see in the Channel Isles all possible gradations, from the well-constructed gréenhouses just mentioned, to the simple shelters made out of thin planks and glass, without artificial heat, which cost only ten cents per square foot, and nevertheless allow of having the most surprising crops quite ready for sale by the end of April. Altogether, the glass-house is no more a luxury. It becomes *the* kitchen garden of the market gardener."

One of the most noticeable features of these islands is the appearance of thrift everywhere discernible. Everything speaks of ease and prosperity; paupers there are none. The poor are rarely seen. Roadside, garden and house alike betoken comfort and sufficiency. Not only are the outskirts of the town filled with substantial buildings, but the homes of the farmers are solid granite structures, it may be with cement floors instead of boards, the roofs thatched or tiled, showing red against the dark, rich background of foliage, but all comfortably, neatly furnished, the windows curtained with cambric or lace, while outside they are bowered in roses, jasmines or myrtles. There is a feeling of home, of ownership, of pride in possession that strikes one at once; and who that has once enjoyed the simple, hearty hospitality of those kindly people will ever forget it? The loaf of cake proffered by the good housewife with a half apology perhaps for it not being as light as it ought to be, the "Jersey wonder" (a species of doughnut) melting away in the mouth before one fairly knows it is there, the pitcher of cider or bottle of wine, — everything is freely offered, and the guest made welcome to the best.. The exquisite neatness which characterizes the house is just as plainly visible in its out-door surroundings. The well-kept walks, the neat, orderly barns and sheds, the gardens with their flowers and fruit, and, above all, the trim, cleanly roads, all bespeak the same care and thrift. Everything is turned to account; the droppings of the horses and cattle along the roads are carefully swept up and placed on the manure heap, the twigs broken by the gales are picked up and put away for fuel, and the leaves falling from the trees are gathered together and carried away to enrich the land. Nothing is lost, and the waste, except in questions of labor, is reduced to a minimum. But the tools are heavy and clumsy, and to this day most of the farmers work their ground with a plough that has a wooden mold-board with an iron point, the horses being hitched tandem.

The roads and lanes deserve special mention. The former are well built, and as a general thing follow the windings of the valleys, while branching from them in every direction are an infinity of lanes, so narrow that at intervals bays are constructed to allow teams to pass each other. No weeds along the margins are to be seen, for both road and lane are macadamized and bordered, sometimes by stone walls or well-trimmed hedges, but oftener by earth banks, upon or beside which are rows of trees. These high, earthen banks, taking the place of fences, with trees growing on top and covered all over with the greenest and most luxuriant of ivies, give to the lanes the appearance of trenches cut in the soil, and this effect is heightened by the arching of the trees overhead and the interlacing of their branches, which even in midday cast a shade that is almost twilight; and for miles you ride along through these leafy bowers, sheltered from the sun, protected from the wind, listening to the song of birds, till at last the vista opens, and suddenly you see the waves rolling madly in, and catch the thunders of the surf upon the granite cliffs.

The question is often asked, To what do the Channel

Islands owe their prosperity? Given an equable climate, a fertile but not rich soil, and a skilful husbandry, and you have the three prime requisites of success. That is true as far as it goes, but there is still a factor wanting to make the explanation complete. Other writers have placed it in the possession of a race of cattle popular throughout the world, a climate which is perfection, and a ready market almost at their very door. To these combined, I would add, "*A diffused property, a diffused capital and a diffused intelligence.*" The 19,000 acres of arable land of Jersey are divided among 2,600 farmers; only six have farms of one hundred acres; some fifty or more own twenty acres, but the great majority have small holdings from one-half acre to five or six. Land does not often change hands. If inherited, it cannot be devised by will, but must follow the line of succession, the law requiring that at death every child shall receive a part, the oldest son having the house in addition. The land laws thus discourage aggregation of property, and favor its distribution among the members of the family. Every man is at the same time a land owner, a capitalist and a laborer. To this "diffusion of property," and to the universal thrift and industry naturally following such diffusion, I attribute the general prosperity of the people. It is natural that a man owning his little piece of land will improve it to the utmost, and make it yield the largest income possible. The man occupying temporarily another's land will not lay out upon it any more than he can possibly help. There results, then, from these small holdings, an intense cultivation not possible on large estates.

How different the case in England may be seen from the following figures: of the 36,000,000 acres comprising England and Wales, 4,500 persons own 20,000,000; 288 hold over 5,000,000; 52 hold over 9,000 acres apiece; 204 hold over 5,000 and 2,432 hold over 1,000. More than one-half is owned by private individuals, holding 1,000 acres and upward. In Scotland this aggregation of land by the few is still more striking. Of its 19,000,000 acres, nine-tenths are held by less than 1,700 persons, and one-half of the whole of its area is held by 70 persons. The whole number of land owners is 131,530, but of these 111,658 own less than an acre apiece. The largest estate is held by the Duke and Duchess of Sutherland, and amounts to 1,326,000 acres. With such a distribution of property, and with a poor law costing thirty-five million dollars annually, what outlook is there for the English farmer? What hope of ever acquiring possession of the little plot of land on which he works and spends his days, or what motive to induce him to improve property he cannot leave to his children? A recent writer puts it in a nutshell when he says: "In England the agricultural laborers, with the lands about them all taken up and so unsaleable, and with a poor law to provide for them under all the calamities of life, whether brought about by mishap or by their own wilful vice, have but little motive, even if they had the opportunity, for saving."

The CHAIRMAN. Unless you have some questions you would like to ask the lecturer, the meeting will stand adjourned until to-morrow morning.

Mr. AVERY. I can verify what President Goodell said in regard to those large pears. In England, when I lived there, it was customary among families giving large parties to hire those pears from Covent Garden market to set on the table for show. If anybody had attempted to buy them they would have cost about a guinea, — that is, five dollars. I have repeatedly seen them displayed in that way.

The CHAIRMAN. I would like to ask how they keep their potatoes?

President GOODELL. They are not put into the cellar, they are kept in the open air or in an open shed, so as to allow a free circulation of the air.

Mr. HALE. I can say that I saw at the Georgia State Fair in Macon pears weighing twenty-eight, thirty and a half and thirty-two and a half ounces, grown in this year of our Lord 1892 in the United States of America.

The CHAIRMAN. We will take your word for it, Mr. Hale.

President GOODELL. I would like to ask Mr. Hale what he has to say about the flavor of the pear to which he has referred?

Mr. HALE. It was not quite so good as an old-fashioned pumpkin.

President GOODELL. That is it. Now, these chaumontel pears are celebrated all over England for their flavor. They are bought in preference to any other pear; but it is the large ones only that are bought; the small ones, although just as good in flavor, are thrown aside.

Mr. VINCENT. I have raised a pear myself that weighed twenty-eight ounces. That was the only pear on the tree. But one of my neighbors raised one that weighed twenty-eight ounces and another one that weighed thirty-two ounces. They went all over the State to different fairs.

The CHAIRMAN. I did some figuring while the lecturer was talking, and I made out that each farmer on the island of Jersey got pretty nearly $2,500 a year.

President GOODELL. It must be somewhere in that vicinity.

The CHAIRMAN. If that is so, those farmers do better than we can in Massachusetts, on the average.

QUESTION. Did you learn what the object was in putting the seed potatoes in those open crates? Does it hasten the maturity of the coming crop?

President GOODELL. I think it is not so much that as to keep them from sprouting until the time when they want to plant them. Just before they are going to plant, they move them from those open, cool places into a warm place, and sprout them. I suppose that is the reason; I did not inquire.

Mr. ——. I have had a Jerseyman on my farm for two years, and he has given me some information in regard to that matter. They are packed in that way for the purpose of sprouting. The main sprout comes from the end of the potato, and when those potatoes are set the principal growth comes from that one sprout. It is very hardy and early.

President GOODELL. They never speak of "planting" potatoes there, but they speak of "placing the sets." That was the term that they used.

There is one thing I wanted to speak of which I forgot. It is not a thing that I saw personally, but they told me of it in two or three places. Instead of employing horse power, they employ women and children in cultivating their potato fields. After the potatoes are up a woman will be seen harnessed to a small cultivator, with two straps over her shoulders, dragging it, and a child or a woman behind guiding it. After they have gone through the rows they set to work with their small iron ploughs and work in between. They are interested in making the farm pay, and every man, woman and child goes into the field and works.

Question. What is the quality of the fertilizers used on the island of Jersey?

President Goodell. Thirty thousand loads of sea wrack, besides large quantities of artificial fertilizers. They spoke of it as guano mostly. They also use the manure that they get from their cattle.

If you have no objection, I would like to give you a little idea with reference to the local flora of the islands. On those islands there are nine hundred and seventy-four different species of flowering plants, ranging clear into the tropical varieties. There are sixty different varieties of trees and shrubs. There are more than one hundred diferent varieties of grasses. There are over four hundred lichens. One of the very interesting things about those islands is that the rocks on those portions of the islands fronting the south and west are very heavily covered with lichens, so much so as to hide the color of the rocks entirely. As you approach the land from certain directions the rocks, instead of naked granite, are covered by the lichens, which give them a beautiful appearance. There are over seventy-five different kinds of mushrooms that grow there on the islands.

Secretary Sessions. There is one fact that perhaps will give us a better idea of the comparative fertility of the soil there than we can get in any other way, and it is this. We have in Massachusetts several single towns of a larger acreage than either one of those islands, and if any one of those towns should yield the amount of productions of which the lecturer has given us a list, it would be considered something marvellous.

Adjourned to Wednesday, December 7, at 9.30.

SECOND DAY.

The meeting was called to order soon after ten o'clock by Secretary SESSIONS, who said: The committee of arrangements have asked Mr. F. H. APPLETON to preside this morning. He is well known to you all, and does not need an introduction. I will leave the matter in your hands and Mr. Appleton's.

Mr. APPLETON. Mr. Secretary and fellow-members of the Board of Agriculture, I hardly need assure you that it is a pleasure for me to be called upon to preside at a meeting of this Board, in which I take so much personal interest, at any time; but it is an especial pleasure to me to preside over a meeting in this locality, which has so much natural beauty and attractiveness about it. I take pleasure in introducing to you a gentleman who is familiar to you for his energetic efforts for the good of this Board,—Mr. BOWKER of Boston.

THE HARVEST OF THE SEA,

OR

THE RELATION OF THE FISHERIES TO AGRICULTURE.

BY MR. W. H. BOWKER.

The harvest of the sea is almost limitless. To consider the subject in its broadest relations would require the knowledge of a naturalist and the experience of a practical fisherman. As I am neither, I shall confine myself chiefly to one phase of the subject; namely, the harvest of the sea in its relations to agriculture, touching briefly upon the food-fish industry by way of introduction. Although we are not as a nation a fish-eating people, yet we are consuming each year larger quantities of the products of the sea. Furthermore, if our new methods of catching fish can be encouraged and fostered by proper legislation, and the methods of transporting it improved so that it can reach the remotest points quickly and in a fresh state, it will become, as it is in Great Britain, the cheapest animal food, and will be consumed in enormous quantities. As it is, the amount of fish which is harvested as food and shipped to all parts of the country reaches immense proportions.

THE FOOD-FISH HARVEST.

It is estimated by Mr. Frederick F. Dimick, Secretary of the Boston Fish Bureau, that "in the year 1891, 74,289,452 pounds of fish, mostly fresh fish, equal in value to $1,636,258, were received in Boston from the fishing fleet." This is equal to 37,000 tons annually, or over 100 tons of fresh fish daily, received in the Boston market. Boston is also a distributing point for salt fish; and Mr. Dimick estimates that in 1891 about 30,000,000 pounds of salt fish, valued at

$1,500,000, were distributed. At Gloucester the receipts of fish during 1891 were 93,817,795 pounds, mostly salt fish, valued at $2,666,171. It is estimated that the fishing-ports of Boston, Gloucester and Providence handle daily at least 300 tons of fresh and salt fish.

According to the United States Fish Commissioners' Report for 1888, the total value of the fish harvest, including oysters, shell-fish, menhaden, and all other kinds used for food, oil or fertilizers, was $11,000,000 in New England, and $34,000,000 for the whole United States; while there were 6,000 vessels and 137,000 men engaged in reaping the harvest.

As an illustration of the harvest of the sea, Mr. Spencer Walpole, for a long time one of Her Majesty's Fish Inspectors of England, states that "in 1880 there were 130,000 tons of fish brought to the London market, while in 1889 there were 193,000 tons, or over 500 tons daily, which is equal in weight to a drove of 1,000 oxen."

Whenever we get to talking about fish, whether caught in the country brook or in the great sea, the figures are always so fabulous that they pass beyond comprehension and usually beyond belief; but those which I have already given you I have taken from official sources, and, to prepare you for future fish stories, I will state, at the outset, that I shall always give my authority.

History of the Use of Fish on Land.

The interest of the agriculturist in the fishing industry is not, however, in the food fish of the sea, of which he consumes comparatively little, but in the kinds of fish which will furnish him with oil to be used in painting his buildings, and with plant food by which he can restore the exhausted fertility of his land, more or less of which has been poured into the sea through the sewers of the great cities.

The Indians first taught the Americans how to recover from the sea the fertility which has been lost to it. Professor Trumbull tells us that the Indian names of Brevoortia, "menhaden" and "poghaden," mean "fertilizer," that which manures; and that the Indians were accustomed to employ this species, with others of the herring tribe, mostly the alewife, in enriching their corn fields. Thomas Morton wrote, in 1632, of Virginia: —

> "There is a fish (by some called shadds, by some allizes) that at the Spring of the yeare passe up the rivers to spawn in the ponds, & are taken in such multitudes in every river that hath a pond at the end that the inhabitants doung their grounds with them. You may see in one township a hundred acres together, set with these fish, every acre taking 1,000 of them, & an acre thus dressed will produce and yeald as much corne as three acres without fish."

This passage is very interesting, as showing the use of menhaden as a source of fertility in Virginia two hundred and sixty years ago.

In Governor Bradford's "History of Plimoth Plantation" an account is given of the early agricultural experience of the Plymouth colonists. In April, 1621, at the close of the first long, dreary winter, he wrote: —

> "They (as many as were able) began to plant their corne, in which service Squanto (an Indian) stood them in great stead, showing them both ye manner how to set it and after, how to dress and tend it. Also he tould them excepte they got fish & set it with (in these old grounds) it would come to nothing, and showed them yt in ye middle of April they should have store enough come up ye brooke by which they begane to build, and taught them how to take it."

In George Mourt's "Journal of the Plimoth Colony," London, 1622, this passage is found: —

> "We set this spring some twenty acres of Indían corn and set some six acres of barley and pease and according to the manner of Indians, we manured our grounds with herring or rather shads, which we have in great abundance and take with great ease at our doors. Our corn did prove well and God be praised."

Again, in the Plymouth Colony records for 1633 we find that at the General Court held the 28th of October, "in the ninth year of the reign of our Sovereign Lord Charles, by the Grace of God, King of England," etc., this order was passed: —

> "That whereas God, by His Providence has caused the fish called alewives or herring in the midst of the place appointed for the

Town of Plymouth, and that the land thereabout hath been worn out to the damage of those that inherit the same, that therefore the said alewives, herring, or shad commonly used in the setting of corn, be appropriated to such as do or shall inhabit the said Town of Plymouth."

In 1639, however, all were forbidden after the 20th of May to employ any cod or bass for manuring the ground; but the Act provided that it should be lawful to use the heads and offal, showing that it had come to be considered a waste of human food to use such fish on the land, except the refuse parts.

In 1652, Edward Johnson, author of "The Wonder-working Providence of Zion's Savior in New England," wrote: —

"But the Lord is pleased to provide for them [the colonists] great store of fish in the springtime, especially alewives, about the bignesse of herring. Many thousand of these they use to put under their Indian corn, which they plant in hills five foot assunder, and assuredly, when the Lord created this corne, He had a special eye to supply these, His people's wants with it, for ordinarily five or six grains doth produce six hundred."

In the town records of Ipswich, Mass., May 11, 1644, is found the following order, which illustrates in a comical way the custom of using fish for manure in these early days: —

"It is ordered that all doggs for the space of three weeks after the publishing hereof, shall have one legg tyed up, and if such a dogg shall break loose and be found doing any harm, the owner of the dogg shall pay damage. If a man refuses to tye up his dogg's legg and hee bee found scrapeing up fish in the corn field, the owner thereof shall pay twelve pence damage beside whatever damage the dogg does. But if any fish their house lotts, and receive damage by doggs, the owners of those house lotts shall bear the damage themselves."

The Nitrogen Question.

Passing through the records to the present time, we find that menhaden and other kinds of fish have been caught in a greater or less quantity for the enrichment of the soil. We have learned, however, in later times, through the efforts of the chemist, that these fish are a source of plant food because they contain nitrogen and phosphoric acid, — two important elements in the building up of plants. This nitrogen which we obtain from fish is termed organic nitrogen, because it was at one time a part of a living organism. It is, however, no better organic nitrogen than is found in many other organic substances, especially dried blood and meat, now obtained from hundreds of slaughter-houses throughout the country, which used to go to waste, or be fed to pigs and converted by them into pork that it is no wonder the Jews refused. The nitrogen obtained from fish is probably not equal as an active agent to many of the chemical salts, such as sulphate of ammonia and nitrate of soda, but nevertheless it is a most valuable, and I might say almost indispensable, source of fertility; and, from an economic stand-point, not only should every pound of refuse fish be utilized, as it is to-day, but in my judgment every fish that can be got out of the sea should be taken, whether it be by line, trap, beam-trawl or purse-seine, for the reason that the world wants cheap food, both for plants and for mankind.

While we now utilize all the refuse from the large fisheries upon the Atlantic and Pacific coasts, such as fish skins, fish heads and fish offal, which is dried and prepared for agricultural uses, — and it amounts to thousands of tons yearly, — yet the great source of plant food in the sea is the menhaden, a most abundant species, which swim along our shores in immense schools from Florida to Maine. As we shall see, they appear to be the scavengers of the sea, and a means, it would seem, of restoring in some measure the fertility that has been squandered by a wasteful husbandry.

Touching the food of the menhaden, Prof. Brown Goode, the head of the Smithsonian Institute, in his admirable paper on the "Biography of the Menhaden," to which I am indebted for much information and many interesting quotations, writes as follows: —

> "The nature of the food of the menhaden has been closely studied. Hundreds of specimens have been dissected, and every stomach examined by me has been found full of dark, greenish-brown mud or silt, such as occurs near the mouth of rivers and on the bottom of still bays and estuaries. . . . The plain inference

from these facts, taken in connection with the habits of menhaden, seems to be that their food consists in large part of sediment, containing much organic matter, which gathers upon the bottom of still, protected bays, and also the vegetation that occurs in such localities."

Professor Goode further says: —

" In the economy of nature certain orders of terrestrial animals feed entirely upon vegetable substances, seem intended for one purpose, — to elaborate simple materials into the nitrogenous tissues necessary for the food of other animals, which are wholly or in part carnivorous in their diet; so the menhaden, feeding upon otherwise unutilized organic matter, is pre-eminently a meat-producing agent."

Mr. Spencer Walpole of England states, in regard to this point, that " the waste mass of decaying animal and vegetable matter which is pouring into the sea practically increases the infusorial life on which the smaller fish feed, and thus enables each estuary to support greater numbers of fish."

If it is the habit of the menhaden to spawn in deep waters, or warmer waters, as appears to be the case, and then in the spring of the year to migrate to our shores to feed upon the deposits of sewage or the lower orders of life produced by sewage, it would seem almost imperative, and a part of our public economy, to allow these fish to be caught, as a source of the much-needed nitrogen so essential to profitable farming.

THE CHEMISTRY OF THE SUBJECT.

The chemist tells us that a plant will not grow without a supply of nitrogen, phosphoric acid and potash, as well as many other ingredients. We know from experience that most of our soils, especially in the Eastern and Middle States, have been exhausted in a great measure of these important elements of plant nutrition, particularly of nitrogen, and that, if we would obtain profitable crops, we must return these elements in some form or other.

The chemist also tells us that the menhaden pomace, after the oil and most of the moisture are pressed out and it has been sun-dried like hay, contains from 8 to 10 per cent of nitrogen and from 7 to 8 per cent of phosphoric acid; that is, a ton of menhaden contains 160 pounds of nitrogen and

140 pounds of phosphoric acid, or 300 pounds of actual plant food, which is worth in the form of fine-ground scraps at least thirty-five dollars.

Following out this line of calculation, let us see how much available plant food has been taken from the sea for the past two decades, or practically before prohibitory legislation was enacted by several of the Atlantic States. The only reliable data that we have extend back for eighteen years, or since the organization of the Menhaden Oil and Guano Association, which is composed of fifty-three concerns, and which employs one hundred and twenty-seven steam and sail vessels. These data, which are taken from the records of this Association, are condensed in the following table: —

TABLE

Showing Amount of Plant Food taken from the Sea in Eighteen Years.

YEARS.	Tons Total Menhaden Fish Scrap (Dry and Acid).	Tons Total Plant Food (Nitrogen and Phosphoric Acid).	Total Value at the Present Rates fixed by the N. E. Experiment Stations.
	Tons.	Tons.	
1874	50,976	106,829	$25,856,762
1875	53,625		
1876	51,245		
1877	61,144		
1878	103,096		
1879	96,622		
1880	70,795		
1881	32,619		
1882	27,581		
1883	45,166		
1884	68,863		
1885	41,135		
1886	18,395		
1887	22,630		
1888	28,044		
1889	50,218		
1890	41,512		
1891	27,677		
	891,343		
Waste fish, all other sources, estimated	150,000	27,500	4,500,000
Grand total	1,041,343	134,329	$30,356,762

NOTE. — Since the above table was presented at the meeting at Spencer, there has been some criticism of it, and I will state just how it was made up. The amount of dry

THE ECONOMIC QUESTION.

We find by the foregoing table that sufficient plant food (excepting potash) was taken from the sea in eighteen years for

700,000,000 bushels of potatoes, or
160,000,000 bushels of corn, or
108,000,000 bushels of wheat, or
5,000,000 tons of hay,

with phosphoric acid to spare in each case.

An examination of the Association Records shows that the largest amount of plant food obtained from the sea was in 1884, when there were taken from our Atlantic waters nearly 69,000 tons of fish yielding over 10,000,000 pounds of nitrogen and 9,000,000 pounds of phosphoric acid; or enough nitrogen and phosphoric acid to fertilize fully

200,000 acres of corn of 50 bushels each, or
500,000 acres of potatoes of 100 bushels each,

with phosphoric acid to spare in each case.

According to the Washington authorities, we cultivated in New England in 1891 250,252 acres of corn, which yielded 9,284,000 bushels. A further calculation shows that in one year we took out of the sea sufficient plant food, excepting potash, to fertilize nearly all the corn grown in New England for 1891.

To put it in another way, enough nitrogen, the most costly part of a fertilizer, was taken from the sea in 1884 to furnish the nitrogen for all the fertilizers sold that year in the New England and Middle States, — fully 200,000 tons.

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scrap reported by the Menhaden Association is 353,911 tons; amount of acid scrap, 537,432 tons; total, 891,343 tons.

The dry scrap was estimated at 8 per cent of nitrogen and 7 per cent of phosphoric acid, although the average of a number of tests showed nearly half a per cent higher in each case. The acid scrap was figured at 6 per cent of nitrogen and 4 per cent of phosphoric acid, and the calculation was made at 16 cents per pound for the nitrogen and 7 cents per pound for the phosphoric acid, no allowance for the reverted phosphoric acid in the acid scrap. It is claimed by some that these figures are too high, but, since the record covers eighteen years, it would have been fair to take the average price for that time, which, according to the reports of the inspector of fertilizers of Massachusetts, averaged, in the case of nitrogen, 20½ cents per pound. The question turns, however, not so much upon the commercial value of the plant food as upon how far it will go in raising crops, as will be seen in the discussion of the economic question, pages 127 and 128.

The entire catch of the eighteen years, as you see by the table, amounts to over 1,000,000 tons, which yielded 134,000 tons of nitrogen and phosphoric acid, worth in round numbers $30,000,000 for manurial purposes alone.

Supposing that *all* the nitrogen and phosphoric acid required for the following-named crops is drawn entirely from this source, we find that the catch of menhaden and the waste fish from other sources for the past eighteen years would yield *more* phosphoric acid than is required and *sufficient* nitrogen for

3,200,000 acres of corn of 50 bushels each, or
7,000,000 acres of potatoes of 100 bushels each.

Need we go further to show the importance of the harvest of the sea in its economic relation to agriculture and to the nation? Is not every State in the Union, whether it borders on the Atlantic Ocean or lies a thousand miles inland, interested in this harvest?

Since the menhaden are such a valuable and abundant source of plant food, and evidently designed by nature in some part to restore fertility, why should our fishermen not be allowed to take them from the sea, provided it can be done without injuring any other industry? This, then, is the problem.

The Menhaden and Blue-fish.

You will notice by the table that the catch of menhaden has fallen off each year from 1884. This year it will not be over 15,000 tons of dry scrap. The falling off immediately after 1884 was partly due to the fact that the fish did not come to our waters; but since 1888, either because the waters have been warmer or the vegetation better, menhaden have come in greater numbers, some years in enormous bodies; yet, owing to the location of the fish and to injudicious legislation, our fishermen have not been able to take them.

The injudicious legislation to which I refer is the result of a feeling that the taking of menhaden in a wholesale way, by the new and improved methods, is robbing the food fish, especially the blue-fish, of their sustenance; also that the spawn of the food fish is destroyed, and the fish themselves, including the menhaden, are driven away; in a word, that the new and improved methods are especially harmful to the food-fish industry.

But what is the evidence? Menhaden are without doubt food for the predaceous fish of the sea, such as sharks, devil-fish, black-fish, whales, porpoises and blue-fish. It is also undoubtedly true that the blue-fish eat menhaden to some extent; but, on the other hand, to what extent, may I ask, do men eat blue-fish? They are the game fish of the sea, and most of them are taken by line fishermen and sportsmen; but they no more constitute the food of the human race than does the wild game of our forests. Besides, the blue-fish are far more destructive of other fish than they are valuable as food. Touching this point, Professor Goode says: —

> "The blue-fish are the most destructive enemies of the menhaden. These corsairs of the sea, as they are sometimes called, not content with what they eat, which is itself an enormous quantity, go through the schools, cutting and tearing the living fish as they go, and leaving in their wake the mangled fragments. Traces of their carnage remain for weeks in the great slicks of oil so commonly seen on smooth water in summer."

Professor Baird, in his well-known and often-quoted estimate of food fish annually consumed or destroyed by the blue-fish, states that probably ten billions of fish, or 25,000,000 pounds daily, are consumed or destroyed on the Atlantic coast.

> "Such calculations," says Professor Goode, "are only approximations. . . . But, applying similar methods of calculation to the menhaden, I estimate the total number destroyed annually on our coast by predaceous animals at a million million of millions, in comparison with which the quantity taken by man yearly sinks into insignificance."

Capt. Daniel Church, who has been a fisherman all his life, and probably the greatest fisherman in the country, at a hearing in Washington last spring, when asked if the menhaden were not the food of the blue-fish, replied that blue-fish did not feed upon menhaden to any extent, and he would stake his reputation as a fisherman on that proposition. When asked by Mr. Sherman Hoar if mackerel did not eat menhaden, he replied that "a mackerel could eat a menhaden about as well as a cow could eat a pig."

But admitting, if you please, that the menhaden are the food of the blue-fish, shall we then allow the menhaden industry to be wiped out in order that a few gamesters and line fishermen may have the opportunity of catching a few thousand blue-fish, more or less, during the summer months?

A gentleman who stands high as an expert in this line, but whose name I am not at liberty to use because of his official position, said to me last winter that he had about come to the conclusion that it would be a blessing to the food-fish industry to have the menhaden removed from our waters when they appear in such enormous schools. "For," he said, "as these menhaden come in, they are followed by the blue-fish; when slaughter begins, the other food fish taking to the woods, as it were."

THE HISTORY OF NET-FISHING.

It is claimed that fishing by net and the newer methods is not only exhausting the supply of fish but is destroying the spawn; but let us consider it in the light of history and modern research.

Fishing by net is as old as history. More than eighteen hundred years ago, —

> "Jesus, walking by the sea of Galilee, saw two brethren, Simon, called Peter, and Andrew his brother, casting a net into the sea; for they were fishers. And he saith unto them, Follow me, and I will make you fishers of men. And they straightway left their nets and followed him. And going on from thence, he saw other two brethren, James the son of Zebedee, and John his brother, in a ship with Zebedee their father, mending their nets; and he called them. And they immediately left the ship and their father, and followed him."

Isaiah speaks of the spreading of "nets on the water;" and in Habakkuk, six hundred years before Christ, we find this reference to fishing with drags and nets (chapter i, verses 15 and 16): —

> "They take up all of them with the angle, they catch them in their net, and gather them in their drag; therefore they rejoice and are glad.
>
> "Therefore they sacrifice unto their net, and burn incense unto their drag; because by them their portion is fat, and their meat plenteous."

M. de Caux, a competent French authority, believes that the drag spoken of by Habakkuk is nothing more nor less than a beam-trawl.

In Oppian's Halieuticks, Book III., written seventeen hundred years ago, we find the following graphic description of the different methods of fishing employed then, which aptly pictures the methods of to-day: —

"By those who curious have their Art defin'd,
Four Sorts of Fishers are distinct assign'd.
The first in Hooks delight; here some prepare
The Angle's taper Length, and twisted Hair;
Others the tougher Threads of Flax entwine,
But firmer Hands sustain the Sturdy Line.
A third prevails by more compendious Ways,
While num'rous Hooks one common Line displays.
The next with Nets wide-wasting skim the Seas,
But diff'rent Forms, with diff'rent Prospects please.
Some hurl the leaded Casting-Net around,
And drag the Circle less'ning from the Ground.
The wide extended Seine and Trammel sweep
The shelving Beach, the Drag-Net skims the Deep.
The Hoop-Net's conick Lab'rinth plies the Shore,
Heave-Nets the Fishes oozy Beds explore.
A thousand Names a Fisher might rehearse
That shun intractable the smoother Verse." . . .

From the English translation by Diaper, Oxford, 1722.

John Bunyan wrote, fifteen hundred years later: —

"You see the ways the fisherman doth take,
To catch the fish what engines doth he make!
Beholdeth how he engageth his wits;
Also his snares, lines, angles, hooks and nets."

There is nothing new under the sun, and it is quite possible that our "new and improved methods" are only the old methods revived. However, we have to-day the steamboat with its purse-seines; and also the large fishing-vessel with its beam-trawl, — a recent importation from Europe, the first vessel of the kind having been built the past year at Essex in this State. By these new and improved methods both food and fertilizer fish can be taken from the sea in much larger quantities and much more cheaply than ever before; and they will come into general use if they are encouraged, rather than hampered by unwise legislation.

The Destruction of Spawn.

As to the destruction of the spawn of food fish by the newer methods of fishing, which is so much feared, Professor Huxley of England, who served for three years on the Fish Commission, gives this testimony: —

> "That the supposed spawn brought up by the trawls turned out to be *nothing but gelatinous inhabitants* of the sea, which had just as much to do with fish as cocks and hens had to do with Jumbo. Such fish as haddock and cod do not lay their eggs at the sea bottom, but they float at the top . . . [and vivify there.] . . . Since 1866 there has been abundant evidence to prove that, while trawlers have gone on steadily increasing, there has been no diminution in the number of cod, haddock and whiting caught." *

Mr. Huxley further states, that, "were trawl fishing stopped, it would no longer be a case of high prices, but that ninety-nine out of a hundred in England would hardly be able to afford fish at all, herrings and a few other fish caught in the old way excepted." *

Injudicious Legislation.

On Dec. 9, 1885, a bill was introduced into the United States Senate, the first and second sections of which read as follows: —

> "It shall not be lawful for any person or persons, by day or night, to put, place, haul, draw or in any manner use any purse-net, pound, fyke, weir or other appliance for the capture of men-

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* "Fisheries of the World," by F. Whymper, London.

haden fish upon the high seas within three miles of the Atlantic coast . . . to be manufactured into oil or into fish guano or other fertilizer material; and that any person convicted of such a crime shall be liable to a penalty of one thousand dollars, of which one-fourth shall go to the informer."

Can we believe, with all the history of the fishing business before us, and knowing that nets and seines were used in ancient times and are still used in all civilized countries, that such a bill would be introduced in our National Legislature? I am glad to say, however, that it was defeated. Yet, strange to say, Maine, New York and New Jersey had previously or have since enacted a law similar to that proposed in Congress; while Massachusetts in 1886 prohibited by statute the taking of any kind of fish by drag-net, purse-seine, etc., in Buzzard's Bay.

You will naturally ask why Massachusetts restricts her legislation to Buzzard's Bay. It is claimed that Buzzard's Bay is the home of the blue-fish; but I am informed that this is incorrect, — they may come there and they may not. But this bay is surrounded by summer residents, many of whom go there for the sport of catching the gamy blue-fish.

It happens that the seiners of the menhaden who have the new and improved methods are mostly citizens of Rhode Island, Connecticut and New York, and they formerly went there with their improved appliances, and scooped up the menhaden in enormous quantities, leaving, however, the food fish alone, often not getting enough in their nets to supply their crews with fish.

The line fishermen, prompted by the sportsmen and the summer residents, feeling that these foreigners were robbing the blue-fish of their food, and perhaps driving them away, came to our Legislature and secured the passage of the Act of 1886, in order, as they claimed, to protect the food-fish industry, but in reality to protect their own sport. They were successful because it happened that both the mackerel and the menhaden catch had fallen off very materially from that of 1884; and they used the argument that these foreigners, with their improved appliances, had scooped up all the fish in the sea, or else had driven them to other waters; whereas the fact was, as it appears now, that the season of 1885 was not favorable to the coming of fish into these waters, and that the so-called "rapacity" of these foreign fishermen had really no influence on the short catch in the years previous to the passage of this law. But meantime the sportsman has been protected in his so-called rights; while the farmer, who has as much right to the fish in the sea as the man who lives along the shore, has been left out in the cold.

The Lapham Bill.

To overcome the State regulations, there was introduced last winter in Congress, by the menhaden and mackerel fishermen, a bill known as the "Lapham Bill," to abrogate the State laws, and permit fishing by citizens of the United States in the bays and inlets along our coast by the newer and improved methods, whether for food fish or menhaden. This bill had the support of nearly all the wholesale fishermen along our Atlantic coast, including the food fishermen of Gloucester, Boston, Providence, Tiverton, New York City and ports on the New Jersey coast.

This bill created a tempest. State rights were involved. Virginia and Massachusetts joined issues. Our Massachusetts Legislature was pretty closely divided; but finally it decided to oppose the passage of the law on constitutional grounds.

The following curious and contradictory memorial in opposition to the Lapham Bill was sent to the Massachusetts Legislature by the selectmen of the towns bordering on Buzzard's Bay: —

> "The natural result of seining, *even in the open sea*, is extinction. It may be said 'population has increased,' but notice the wonderful fertility of the fish. Hand-line fishing never did and never can destroy the fisheries.
>
> "If comity, decency and fair play were eliminated from the matter, and only the basis of selfishness left, it would still be to the interest of the inland towns to preserve the fisheries of Buzzard's Bay as a source of food supply.
>
> "In other words, the same senseless rapacity of man which has exterminated our buffalo, which has destroyed the whale fishery, which is aiming to ruin the fur-seal fishery of Alaska, and which

would, if unchecked by legislation, kill all Massachusetts game in a few years, has found even the apparently inexhaustible fertility of the ocean unable to resist the assaults of netting." (From the "Boston Herald.")

THE EXTINCTION OF FISH.

It will be noticed in the first paragraph that the memorial speaks of the wonderful fertility of fish, while in the last paragraph it compares the extermination of fish to the extermination of the buffalo and the whale, overlooking the fact that there is really no comparison between the two. The buffalo, the whale and the seal belong to the family of mammals, which reproduces itself, like the cow, once a year; while the fecundity of fish is beyond comprehension.

The cod's roe, for example, has been occasionally known to be half the gross weight of the fish itself; it is even stated that a female cod has been caught with upwards of 8,000,000 eggs. About this statement there is probably a certain proportion of guesswork; it is at least a little fishy. The roe of a sturgeon, however, when partially dried, will yield several hundred pounds of caviar.

According to Colonel McDonald, our present Fish Commissioner, the menhaden, although not much larger than the herring, is said to have five times as many eggs. "The herring has about 35,000; and a menhaden taken in Narragansett Bay Nov. 1, 1879, contained at least 150,000 eggs."

To compare the extinction of fish with the extinction of the buffalo is like comparing the sun to the tallow candle. Where there is one buffalo or one deer born and which can be located, there are millions upon millions of fish hatched each year, which inhabit the unfathomable waters that comprise three-fourths of the globe. The selectmen around Buzzard's Bay might as well think of pumping the ocean dry as of exhausting it of its fish by any means which man can employ.

Oppian wrote, in the second century: —

> "Yearly their Eggs the pregnant Females lay,
> One annual Birth restores the vast Decay."

CONCLUSIONS OF THE ENGLISH COMMISSIONERS.

The English, however, have been over this ground pretty thoroughly. Fearing that the improved methods might exhaust the fish along their coast, the British government appointed a commission to investigate the matter.

This commission, composed of James Caird, Prof. T. H. Huxley and Geo. Shaw Lefevre, was appointed in 1863 by the Queen, to inquire into the following points: —

1. Whether the supply of fish from the sea-fisheries is increasing, stationary, or diminishing.
2. Whether any of the methods of catching fish in use in such fisheries involve a wasteful destruction of fish or spawn; and, if so, whether it is probable that any legislative restriction upon such method of fishing would result in an increase of the supply of fish.
3. Whether any existing legislative restrictions operate injuriously upon any of such fisheries.

After three years of careful research, the commission reported as follows: —

In conclusion, we are clearly of opinion: —

1. That fishing by the use of the beam-trawl is the source of by far the greatest and most progressive supply of fish, other than herring, to the principal markets of this country; that certain descriptions of fish, such as soles and plaice, could not be largely supplied by any other mode of fishing; that it engages the largest capital, employs the most numerous body of hardy fishermen, is the least under the control of the weather, and obtains the greatest returns of fish for the labor and capital employed.
2. That there is no reason to believe that trawling in the open sea destroys the spawn of fish.
3. That trawling in the open sea involves the capture of a certain very variable proportion of small fish, which is wasted or not, according to circumstances.
4. That there is no evidence to show that trawling has permanently diminished the supply of fish from any trawling ground, but that there is proof to the contrary.
5. That trawling in the open sea has not interfered with the supply of fish from line fishermen; unless it be by catching, in a more expeditious and regular manner, fish which the line fishermen might have taken.

6. That trawling in the open sea is not shown to be a wastefully destructive mode of fishing, but the contrary.

7. That any legislative restriction upon trawling in the open sea would result in a very great decrease in the supply of fish.

THE SCARCITY OF FISH.

This talk about the scarcity of fish is not new. It has been going on from time immemorial.

Mr. Spencer Walpole reminds us of the good Bishop of St. David's, who was burned at Carmarthen for heresy in the reign of Mary, and who affirmed the opinion that the scarcity of herrings in his time was due to the covetousness of fishers, who in time of plenty took so many that they destroyed the breeders. This was three hundred and thirty years ago, and it is doubtful whether more than one herring was taken then for every ten thousand now.

Another bishop, at the commencement of the last century, strongly impressed with the approaching destruction of the herring fishery, directed a special prayer to be offered in every church of his diocese for its restoration and continuance. This prayer is still read every Sunday in the Isle of Man.

Again and again since that time the same cry has been raised. "In the year," says Mr. Walpole, "that our queen ascended the throne, I found a petition which had been presented to Parliament, that the fishermen of Ireland, Scotland and Holland had found out the breeding-places of the herring, and that since the discovery was made the fish throughout the west and north of Scotland had annually decreased. . . . It is a striking fact, that, at the very time this petition was presented, the herring fishery was increasing year by year, and its yield now is more than four times what it was at that time."

It reminds one of the prophecy which we now occasionally hear, and which was frequently heard by our ancestors, that the world was certainly to end within the next hundred years.

After alluding to the recent scarcity of soles, in 1882, Mr. Walpole tells the story of a fisherman who forty-five years ago landed at Scarborough with a single pair of soles, which he displayed on the pier, solemnly shaking his head and stating to the bystanders, "*These are the last two soles in the North Sea;*" but it is needless to add that millions more have been caught since.

The Government Fish Inspectors of England for 1878 estimated that the increase of herring in one season, if none were destroyed, is sufficient to make a solid wall about two hundred feet broad and one hundred feet high, reaching around the greatest circumference of the earth. This is the biggest fish story I ever heard, but you will find the whole mathematical calculation in an English Government Blue Book on Fisheries.

After this playful ponderosity on the part of the English Fish Commissioners, we find them seriously stating that, so far from the stock of fish decreasing, "*the supply of fish taken, on the whole, is at least as great as it ever has been.*"

Colonel McDonald, when questioned last May by Senator Stockbridge of Michigan upon this subject, stated that on the coast of Norway the herring fishery had been prosecuted during a period of fully one thousand years, and quoted Professor Huxley as stating that "it is safe to say that, scattered through the North Sea and the Atlantic at one and the same time, there must be scores of shoals of fish, any one of which would go a long way towards the whole of man's consumption of this fish." Colonel McDonald remarks: "Calculating upon this basis, and there is none better, the herring fishery of northern Europe has probably yielded during the past four hundred years about twelve hundred billions of fish;" and he adds, "There is no evidence that the herring has been diminished as a result of the fishery."

THE MIGRATION OF FISH.

Touching the coming and going of the menhaden, Colonel McDonald says: "The most potent influence upon their migration is believed to be the temperature. The schools arrive when the surface temperature of the water rises to above 51°, and then depart any time when the temperature falls below this point."

Speaking of the migration of fish, Mr. Whymper, a competent English authority, writes: —

"We all know the enormous influence which a warm or cold year has on the production of insects and on vegetable life. Precisely the same thing occurs in the sea, and the minute forms of life on which fish feed are very sensitive to the cold or warmth of any particular year. When there is a scarcity of this form of life, the fish are obliged to scatter in search of food, and are not together to be easily caught by the net fishermen; but the great safeguard against the exhaustion of the fish harvest is found in their wonderful productive power."

The Hon. Mr. Atwood, member of the Massachusetts Senate from the Cape District in 1878, stated that he had been engaged in the fishing business for fifty-one years, and that there was no accounting for the coming and going of fish. He says: —

"About 1840 there appeared on our coast south of Cape Cod large quantities of shad, and fishermen from Massachusetts, Connecticut and Rhode Island engaged in this fishery and found it profitable. In 1842 an act was passed by the Legislature to prevent fishermen from other States fishing for shad within our waters. I myself engaged in this fishery, but we found there was no need of the passage of such an act, as the shad appeared in small numbers, so that not enough were caught to pay expenses. What was the cause of their coming, what was the cause of their going?"

There have also been great changes in the coming and going of our common mackerel. While in some years they come to us in great abundance, in other years they are comparatively scarce. In 1831, before these novel methods were introduced, there were 385,000 barrels caught; in 1841, 50,000 barrels; and in 1870, 243,000 barrels. As Mr. Atwood says, "It would seem that the catch of fish from year to year differs as widely as the product of our land."

The same argument was advanced in 1878, when it was proposed to have an international treaty with England, to prohibit the use of purse-seines. Mr. Rich, a large fish-dealer in Boston, delivered a lecture in which he stated that mackerel were gone, never to return to us, unless purse-seine fishing was prohibited; and yet, notwithstanding this prophecy, the catch of mackerel never was so great as it was from 1880 to 1885.

Hasty Legislation.

It would seem that the fishermen themselves have not known what they wanted; for this matter of catching fish in a wholesale way has been several times before our Massachusetts Legislature. In 1870 a petition was presented, stating that the practice of pound fishing and drag and purse seining was seriously prejudicial to the production of fish, and it was prayed that the Legislature would by suitable enactments protect such fishermen and those of the community interested in their continuance, and forbid "*these novel and improper modes* of fishing."

But it was proved then, as it will be proved again, that these "novel and improper" methods of fishing are not novel, as we have seen, and are not exhausting the supply, but are in the interest of the food supply for man and for plants.

As an illustration of our foolish and hasty legislation, Congress passed in 1887 a law prohibiting the taking of mackerel of a certain size for five years, with purse-seines and nets. It was expected by the promoters of the law that mackerel would soon swarm in all our waters from Cape Cod to Eastport. The figures of the Fish Commissioner tell their own story. They show that the smallest catch in the history of the business was during the years 1890 and 1891, three and four years after the passage of the law. As some one has said, "We may pass as many laws as we choose, but we cannot make fish bite or a horse drink by legislation."

They come here, as we have seen, to feed upon the crops of seaweed and infusorial matter upon our coasts; and if the supply at the mouths of our rivers and in our large bays, like Buzzard's Bay, is adequate, and the weather is favorable, they will come, stay until they get fat, and then go back to their old hatching-grounds, to come again the following season if weather conditions are again favorable; and this is no doubt true of many of the food fish, such as herring, shad, mackerel, etc.

State Rights and the Fisheries.

But there is another phase of this question which I wish briefly to consider. It was said that the Lapham Bill was unconstitutional, as it interfered with State rights. It was claimed that the United States had no jurisdiction in what is called "territorial waters;" that is, within three miles of the shore of any State.

As I am not a lawyer, I will not presume to offer any opinion; but if we go into the history of the formation of this government, and in fact before the government was formed, we shall find that the fisheries were considered a part of the commerce of the country, and that the preservation of the rights of the people of all the United Colonies in the sea fisheries was commonly put forward as one of the chief objects and sometimes the principal object to be obtained by the formation of the Federal Union. In 1782, when John Adams and Benjamin Franklin were in Paris negotiating the terms of the treaty of peace, it was made the *sine qua non* of the negotiation that the rights of the people of the Colonies in the sea fisheries should be preserved to them.

Again, in the debates in the convention that created the Federal Constitution, the fisheries were considered an important branch of our commercial interests, which the Constitution was expected to preserve and to regulate. Mr. Hamilton, in "The Federalist," wrote, "The fisheries are the rights of the Union, and a matter of great moment." Gouverneur Morris said, "The fisheries and the Mississippi are the great objects of this Union." The brilliant Fisher Ames stated: "The taking of fish is a very momentous concern. It forms a nursery for seamen, and this will be the source from which we are to derive maritime importance;" and Elbridge Gerry emphasized the same point.

Legal lights of our own day affirm the same opinion. Mr. Dana, counsel for the United States in the Fishery Awards Commission at Halifax, said that he would stake his professional reputation, or rather his reputation as a man knowing anything whatever about international law, upon the proposition that a fisherman or mariner pursuing fish upon the high seas, up to the low-water mark, upon the coast of any country, *was not a trespasser.**

Says Mr. Joseph H. Choate, in the case of Manchester *v.*

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* From the argument of Mr. Joseph H. Choate, in the case of Manchester *v.* the Commonwealth of Massachusetts, before the United States Supreme Court.

Commonwealth:* "I maintain the proposition that there is no exclusive right of property in the citizens of Massachusetts in the high seas, or any fish in the high seas, within a distance of three miles of her shore."

Mr. Justice Bradley, in one of his opinions, writes: —

> "The Constitution of the United States having given to Congress the power to regulate commerce, not only with foreign nations, but among the several States, that power is necessarily exclusive whenever the subjects of it are national in their character or admit of only one uniform system or plan of regulation."

Mr. Choate, commenting on this opinion, says: —

> "If Massachusetts can regulate this part of commerce upon the high seas, it must be only because of a right of property; and if she has such right of property in the high seas for three miles from the coast, and in the fish therein, she can go further, and, in virtue of the same right of property, grant an exclusive right of fishing. The mere fact of the common interest of the people of all the forty-four States in this industry [meaning the menhaden fisheries] demands that it should be subjected and controlled by a uniform system or plan of regulation."

The English Commission, in their report to which I have referred, said: —

> "Leaving out of consideration the comparatively few cases in which private rights of sea-fishery exist, it may be laid down as a broad principle that, apart from the restrictions prescribed by international law, or by special treaties, the produce of the sea is the property of the people in common, and that methods of fishing are fitting subjects for legislation only so far as such legislation can be shown to be necessary to secure the greatest possible advantage to the whole nation from the sea-fisheries, either by suppressing wasteful and uselessly destructive modes of fishing, or by removing legislative obstacles in the way of improved modes of fishing, or by preserving peace and order among fishermen."

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* This case was decided in favor of Massachusetts. But the U. S. Court said: "We do not consider the question whether or not Congress should have the right to control the menhaden fisheries, which the State of Massachusetts assumes to control, but we mean to say only that as the right of control exists in the State in the absence of the affirmative action of Congress taking such control, the fact that Congress has never assumed such control is persuasive evidence that the right to control them still remains with the State."

The Nub of the Matter.

Our coast waters belong to the whole country, and hence there should be one supreme law. The whole country is taxed to improve and defend them, and therefore the wheat-farmer of Ohio, the cotton-planter of Tennessee, the potato-grower of Maine or the market-gardener of Massachusetts has as much right to ask that the nitrogen and phosphoric acid which can be harvested out of the sea in the form of menhaden or other fish should be taken for the benefit of his exhausted farm, as the sportsman has that he should be protected in his right to fish off his piazza on Buzzard's Bay, or the line fisherman that he should take a few mackerel in the old-fashioned way for his support.

I admit that we do not want any hasty judgment; but when it is urged that the catching of menhaden in enclosed waters like Buzzard's Bay is detrimental to the food-fish industry, and therefore should be prohibited, it is going too far. New methods of fishing are as important as new methods in any other industry, and should be fostered. We might as well propose that the steam and electric railway should be abolished in the interest of the horse-breeders, and that the mowing-machine should be discarded in the interest of the farm laborer; while the hand shoemaker may claim that the modern shoe-shop, with its improved machinery, is interfering with his livelihood, and therefore should be abolished. We are moving ahead; and any new method which will secure greater benefits to mankind should be encouraged, whether it relates to the shop, the factory, the sea or the land.

The Policy of the Government.

It has been the policy of our government to admit plant food from all sources, including foreign countries, free of duty; and it is a right policy. The plant-food industry has been built up on a free-trade basis, and, fortunately, it can live on that basis. It asks for no protection; but what must be said of a policy that admits plant food free from foreign countries, including even menhaden, and at the same time prohibits the taking of this same fish from our own waters?

As a result of this policy, there have been lost to agriculture hundreds of tons of plant food. Furthermore, the defeat of the Lapham Bill will put thousands of dollars into the pockets of the slaughterers and packers of the country, who manufacture a material similar in composition to menhaden scrap. The slaughtering business of the country is said to be controlled by four concerns, known as the "Big Four." Whether it is or not, it is safe to say that these four concerns produce at least fifty thousand tons yearly of fertilizing material, and will profit by the defeat of the Lapham Bill by just so much as the catch of fish is decreased on that account.

The slaughterers of the country could very well afford to contribute to the maintenance of State regulations that interfere with the harvest of food products from the sea, for such products come in competition with those which they produce.

If there had been the usual quantity of food fish, especially mackerel and menhaden, taken from the sea this year, as it is believed there would have been except for the prohibitory legislation, it might have had a material influence upon the price of meat products; and it certainly would have had a very great influence upon the price of fish scrap to the tobacco-grower in the Connecticut valley and in Virginia, who this year will have to pay from five to seven dollars a ton more for it than he did in 1891.

The great catch of menhaden from 1875 to 1885 was one of the chief factors that brought down the price of commercial manures and guano from sixty and seventy dollars a ton to forty and forty-five dollars a ton; and it will have just as potent an influence in the future as it has had in the past.

The food-fish industry should be protected first; and if food fish can be taken in larger quantities by improved methods, as is the case in Great Britain and France, without exhausting the supply, then it becomes an economic question of so much importance that both the State and the nation should seek to protect and encourage such methods in this country. Further, if it can be shown that the menhaden species can be taken in a wholesale way without interfering at all with the food-fish industry, and probably helping it, then this also should be protected and encouraged in the interest of husbandry. In short, any method that shall increase the food supply of man and help to build up our agriculture should be fostered by the government.

Its Bearing on the Eastern Farmer.

For the Eastern farmer this question of plant food is becoming a serious one. We have drawn our principal supplies from the great packing and slaughtering houses of the West; but the time is not far distant when every pound from these sources will be used on the great wheat and corn fields nearer home. When that time comes, and it will be here very soon, the Middle and Eastern States farmer, as well as the cotton-grower of the South, will be forced to pay much higher prices for his plant food, unless he is allowed to draw upon the inexhaustible stores in the sea.

Here is a crop that comes to our shores almost every season, if the weather is favorable. It is a crop which should be harvested like a crop of corn or a crop of clover. It is here to-day and gone to-morrow, perhaps to be eaten up by predaceous animals and lost forever to man's uses. Like a crop of clover, it must be taken at the right time, *whenever* and *wherever* it appears, while I believe no one will be harmed and the world will be enriched to the extent of the harvest.

We are urged by the scientists to grow clover as a conservator of nitrogen. Here is a crop of nitrogen right at our doors, in the shape of fish which should be secured especially by the Eastern farmer, who cannot afford, like his Western brother, to plough in a crop of clover.

God has put the fish into the sea for the benefit of man, not for any class, but for all mankind. He has placed these treasures in the sea in great variety and luxuriance, the same as he has placed in the mountains and valleys other treasures to be utilized and enjoyed by man.

The Appointment of a Commission.

This is of such great importance that it should not be allowed to drift; and if we are undecided as to the best course to pursue, let us appoint in this country, as was done in Great Britain, a commission composed of scientific and practical men to take the matter under advisement. I believe if such a commission is appointed it will decide, as it did in Great Britain, that the new and improved methods of fishing have not exhausted and cannot exhaust the supply of fish, and therefore for the public good their use should be permitted in any waters of any State of the United States.

What the Experiment Stations should do.

In closing, I want to urge the agricultural experiment stations of the country and the boards of agriculture of the different States to take this question under consideration. I was sorry, when it was up for discussion at Washington last spring, that not a representative from any station in the Union was in attendance to present the agricultural side of the question. I regretted, when the matter was up in Massachusetts, that no representative from our two stations, the Massachusetts and the Hatch, was present at the hearing.

Our experiment stations have done a great work in developing the plant-food industry and in looking up and presenting to the public new sources and forms of plant food. Now that a great source, perhaps the greatest source, is jeopardized, it seems to me that the directors of our stations, as representatives of the farmers, should be on hand to present their side of the question.

A Personal Word.

Brother members of the Board of Agriculture, you know me as a manufacturer of fertilizers, and naturally you may ask if I have any personal interest in this matter. Let me assure you that I have not a dollar's interest in any fishing enterprise. Personally, I do not care whether one menhaden or one billion are taken from the sea. As a manufacturer of chemical manures, it is my business to collect plant food wherever I can find it. If the menhaden fisheries should be wiped out to-day, the fertilizer manufacturer would secure plant food from other sources, probably drawing on foreign countries, especially Chili, for nitrate, and sending his money abroad instead of keeping it at home.

The Chairman. We have had a very interesting paper, and it has proved to us that the story is not only interesting, but may sometimes be very important. We have with us a gentleman who is very familiar with the subject, Capt. Church of Tiverton. We should be glad to hear from him.

Capt. Daniel T. Church (of Tiverton, R. I.). I did not come here with any intention of making a speech; I came to hear what my friend had to say. He has very thoroughly covered the ground. I am very glad that he has opened the campaign of education, for as toilers of the sea, we know from the illustrations that he has given, that the harvest gathered from the sea is a very large and valuable one, especially in the form of fertilizers. We have had a practical illustration of its value in the last year or two. The price of ammonia within the last year has advanced from $1.75 per unit to $2.00, $2.20 and $2.30. That is the difference it makes to the farmer; and one of the main reasons for that advance has been the shortage in the catch of menhaden. The main reason for the shortage has been the interference of Massachusetts, Maine and New York with our fisheries. Practically from the foundation of our government up to within four, five or six years there has been almost absolute free fishing in this country. Laws have been introduced into the Congress of the United States to interfere with it, but they have been always headed off. There have been laws passed by the States, but practically those laws have never, until recently, been enforced. Within the last three or four years laws have been enacted in some of the States which have attached certain conditions to fishing, which, if carried out, will destroy the fisheries.

Speaking in a general way, our business is being destroyed, and destroyed by men who do not understand the merits of the case. I am convinced that if the people who make these laws understood the merits of the case exactly as they are, they would be as much for the fisheries as we are ourselves. The idea that man is an enemy to fish, or that any means which he can use to catch them has any perceptible influence on their number, is a mistaken idea. All history goes to prove it. Mr. Bowker has gone away back to the time before Christ, and all history proves, as I say, that man has not affected the number of fish in the sea. Fish come and go without regard to man. The reason of their coming or going we do not know. The general result is, that it is for the public benefit, especially for the benefit of farmers, who, we know, are the foundation of everything as far as our commerce is concerned, that our fisheries should be unrestricted. Our fishermen are not getting repaid for the labor and expense they put out, and it would seem that, if the farmers can be the means of helping them by buying fertilizers, they should be protected and helped instead of being ruined and destroyed.

Mr. Cushman. I have been very much interested in this paper this morning, although I came here without any particular knowledge of the question that was to be presented before this body. I reside within some fourteen or fifteen miles of the shores of Buzzard's Bay. I am not particularly interested in the fisheries in any manner whatever, but I wish to say to you, gentlemen, that this is an exciting question, not only to the farmers, but to all the residents along the shores of Buzzard's Bay. The fisheries of that bay are valuable to the inhabitants of that section, not for the fish alone that are taken from the waters, but they consider that the fish enhance the value of the land. It is to the value of the land that they look, and it seems to me that this paper and this discussion is drifting away a little from the agricultural point. This question appears differently up here in Spencer to you gentlemen who live a long distance from Buzzard's Bay from the aspect it assumes down there. It is a local question to the people there, and the point is just here: there has been a great deal of excitement over the seizure of vessels in Massachusetts waters. Vessels have been seized that were engaged in taking *their* fish, as they consider. Foreigners (I use the term as the speaker did) come into the waters of those people with their steam vessels, and scoop up their fish in their nets, etc., and take them away into a foreign land, and it becomes there a local question. I am rather sorry that it has been brought into an agricultural meeting for discussion. I have heard this question discussed a great deal by the inhabitants on Cape Cod and the people who live on the shores of Buzzard's Bay. I think they know pretty well what they want, and know pretty well about the fisheries of Buzzard's Bay. I am acquainted with scores and perhaps hundreds of men who have spent their lives since childhood fishing, and I say again that I think they know pretty well what they want, and understand pretty well their own interest; and I tell you, gentlemen, they do not want, and they do not mean to have, foreigners coming and scooping up whole ship-loads of their fish and carrying them away out of their waters.

Mr. Ware. I would like to ask Mr. Bowker why that record does not go back farther than 1874?

Mr. Bowker. The only official record that we have of this particular kind of fish goes back only to 1874; the record of mackerel goes back farther.

Mr. Ware. It is well known that the hereditary instinct of many kinds of fish is very remarkable. It is known that the fry of salmon, alewives and shad, if put into a river, will go down into the ocean and return to the same places. The habits of fish become instinctive, and anything that interferes with the natural habits of fish tends to change that instinctive influence, or whatever it may be, that makes them return to certain localities. Now, then, I live upon the sea-shore, my farm bounds upon the ocean, and there is a cove right in front of my land. Many a time in my younger days I have seen that cove filled with menhaden, and we have put in a seine and hauled them in until we have had hundreds of barrels to cart right on the land and apply at once, then and there. Since the fishermen have adopted this wholesale destruction of the menhaden on our shores they do not come there any more. I have not seen my cove filled with menhaden for twenty years, perhaps. We do see them occasionally in the bay, but not anything like the amount that there used to be.

Now, my friend Bowker I think has proved a little too much for his own position. He stated from the highest authority, I will admit, from the Smithsonian Institute, that menhaden live upon the sewage flowing into the sea from the large cities and the vegetable growth along the shore, and he calls them "the sea scavengers." Now, any legislation that will protect our shores within the three-mile limit and allow those scavengers to come to our shores and eat up the sewage must tend to the improvement of the sanitary condition of the people along the shores. There is a doctor in Boston of a good deal of repute who has stated publicly that he would not recommend any of his patients to go on the north shore nearer Boston than Beverly shore. Possibly he may be specially interested in real estate on Beverly shore; I do not know about that. I am living nearer Boston than that; I keep a summer hotel right on the sea-shore, and I have no doubt that the doctor's statement has interfered with my business somewhat. Now, then, I am interested, as you see, that the waters of Massachusetts Bay shall be purified by these menhaden fish; and if they are allowed to come in thousands and millions to eat up the sewage from the city of Boston as it enters the bay, it is going to protect the health of the people all along the north shore, according to the statement that was made here to-day. Let us look at it from that stand-point, — the health of the people. If they are scavengers of the sea, don't for mercy's sake drive them away from the shore into deep water, where they cannot follow the instinctive impulses of their nature as God intended that they should, and eat up the sewage from the city of Boston. Let us have the full benefit of that, and let us preserve any legislation that protects us, putting aside the great amount of commercial fertilizers that may be produced by the catching of these fish. You see there has been a great diminution all the way along from 1883. Let us not interfere with any legislation which will have a tendency to increase the number of these fish upon our shores. I put it upon the ground of the evidence that has been produced here, that they are scavengers of the sea, and that the health of the people along the north shore depends upon their free coming into Boston Bay to eat up the sewage. Don't interfere with that.

Hon. JOHN E. RUSSELL (of Leicester). I would like to have the lecturer answer one or two questions. I want to ask him if he regards Buzzard's Bay as part of the open sea, over which the United States has jurisdiction.

Mr. BOWKER. I believe that is considered a disputed question.

Mr. Russell. Massachusetts has never allowed that Buzzard's Bay was part of the open sea.

Mr. Bowker. I believe it was considered a part of the open sea in the early history of Massachusetts; later the State began to pass restrictive legislation.

Mr. Russell. Do I understand the lecturer as proposing that the government of the United States should take charge of the inland waters of Massachusetts, or any of the other States?

Mr. Bowker. There are two phases of that question. One is police regulation. The State, no doubt, should have that under its charge; but fishing on the part of foreigners on the coast, who are themselves outside of ordinary police regulation, should come, as I look at it, within the regulations of the general government, because food fish and fertilizer fish may appear one week in Casco Bay, then in Massachusetts Bay, — they have appeared right here where brother Ware lives, although he does not recall it; they may appear in Buzzard's Bay, again in Long Island Sound, or anywhere along the coast, and, not knowing when and where they are coming, there should be certain regulations which will allow these fertilizer fish to be taken whenever and wherever they appear; but any fisherman taking food fish along with them and destroying them should be prosecuted, for the food-fish industry should be protected first.

Mr. Russell. Then you would hold, with Mr. Choate, who is merely a retained advocate on one side, not a public man speaking on this question, — you would hold with him that the States should give up their control of the bays, estuaries and shores to the general government?

Mr. Bowker. That does not follow, provided the States will pass regulations that will admit of the taking of these fish by the newer methods. It is immaterial to me whether the United States government regulates this matter, or the States, provided they are harvested like a crop of grain, and not allowed to go to waste. But different States have looked at it in different ways, and passed different regulations, and a fisherman with the improved methods never knows where the boundary lines begin, and whether he is obeying the law of one State or another State. He is all at sea, as it were.

Mr. Russell. Then, if a State makes laws that suit your side of the case, you would not propose to have the government of the United States have anything to do with it; but, if a State does not make such laws, then you think that the government of the United States should take charge of it?

Mr. Bowker. It is immaterial to me, provided we can harvest the crop from the sea when it comes here. But I think the general government should go back to its old rule before the government was formed, — that the fisheries were a part of commerce, and that commerce should be regulated by the general government.

Mr. Russell. I do not agree with you that it was ever considered by the government of the United States, since the adoption of the constitution, that it had charge of anything except the deep-sea fisheries. They may be regarded as commerce. The objects of our fathers in coming upon this continent, as was stated more than two hundred years ago, were "to worship God and catch fish." A hundred and fifteen or a hundred and twenty years ago the fisheries were so extensive that Edmund Burke said in Parliament, "There is no sea but is vexed by their fisheries, no climate that is not a witness to their toil;" but never was there a time when the colony of Massachusetts or the State of Massachusetts has not reserved to itself the right to control its own coast, bays and estuaries; and I doubt very much if this Commonwealth proposes, even under the very loose and wide construction of the present time, to give up any such right as that to the government of the United States. It would be a concession more important than ever has been made to the government.

Mr. Bowker. True; but that issue is coming.

Mr. Russell. Well, it is a better time for it to come on now than it was, for I tell you the constitution of the United States is to have a renewed reverence.

Captain Church. As I understand, the government of the United States has made two treaties with the government of Great Britain since the formation of the constitution, wherein the government has granted to British subjects the right to fish in every harbor, bay and river of the whole

United States. Now, if the government of the United States did that, did it have the right, or not?

Mr. RUSSELL. Will you please mention what treaty that was?

Captain CHURCH. What they call the Halifax treaty.

Mr. RUSSELL. Is that treaty in existence?

Captain CHURCH. No, sir, it is not in existence; I did not say it was in existence. I say the government of the United States has done that thing.

Mr. RUSSELL. The treaty between the United States and Great Britain is the treaty of 1818. That is the treaty which is now held in abeyance, and our fishing is simply protected by what was called the *modus vivendi* of five years ago, and we are liable to come right under that treaty, and liable to have fishing vessels seized under it at any time.

Captain CHURCH. The gentleman said that that thing had never been done. It has been done twice.

Mr. RUSSELL. What I said was this, that the State of Massachusetts had never proposed to part with any right over her own territory and over the waters and bays in her territory, and I doubt if she ever has; and there is no existing treaty that does interfere with those rights.

Captain CHURCH. The gentleman knows and everybody knows that those treaties were made by the government of the United States. There was not one word of protest uttered by any Senator or Representative of this State when those treaties were confirmed by the government of the United States. Now, if the State of Massachusetts did have the rights that the gentleman says, and those treaties interfered with the rights of this State, why was it that the Senators and Representatives of this State made no protest against them?

Mr. RUSSELL. I want it understood that the State of Massachusetts has resumed her rights.

Captain CHURCH. We have always been in the enjoyment of free fishing from the foundation of the government of the United States. We have always had a license, and that license says that we have a right to fish. We supposed that that license was sacred, that it meant something. We were arrested in Buzzard's Bay under this law of 1886. We appealed to the supreme court of the United States, and asked for the protection that we supposed that license gave us; but the United States supreme court said that, in the absence of any specific grant of that right to the government of the United States, or something to that effect, the right remained with the States to control that fishing. The fishermen of the country have, I think, between thirty and forty millions of dollars invested in their industry. Now, if any State can stop men from fishing, what is all that property worth? It is worth nothing. The great majority of our fishermen are citizens of Massachusetts, and yet we are dubbed "foreigners." Is that correct? Is that American citizenship?

Mr. RUSSELL. The gentleman need not be sensitive about being called a "foreigner" in a legal sense. We speak of "foreign insurance companies" and other corporations because they are located in other States. It is not a term of reproach, it is merely a term of convenience. That has nothing to do with this discussion. The trouble seems to be that the gentleman is in conflict with the laws of the Commonwealth of Massachusetts. I would suggest that the people of Massachusetts reform those laws, if they are not what they should be; but I do not want to have the argument made here that we are to go to the government of the United States to overrule the Commonwealth of Massachusetts in her own waters. There is the point. The Commonwealth of Massachusetts has certain rights over her own territory, and, if those rights have ever been in abeyance and ever been taken possession of by the government of the United States undisputed, under the law as it exists at the present time the Commonwealth has resumed her rights and her power. The gentleman's conflict is with our legislation. I have no objection, of course, to this matter being settled by the Legislature of Massachusetts. The right way to get a remedy for any evils that may exist is to go to the Legislature.

Mr. CUSHMAN. If you talk with the men who live on the shores of our inland waters or who live on the shores of Buzzard's Bay, you will find that those men have inherited the idea that the fish in those waters belong to them, and they do not propose to have the Rhode Island fishermen coming in there and scooping them out. That is the way the thing stands at present.

Professor Roberts. My geography is a little rusty, and I would like to know where the eastern boundary of the Commonwealth of Massachusetts is. That seems to be where the trouble lies in this discussion. One man seems to think it is at one place, another thinks it is at another place. The question is, does the authority of the Commonwealth of Massachusetts extend one mile or three miles or ten miles into the sea? It seems to me the whole thing hinges on the eastern boundary of the Commonwealth of Massachusetts.

Mr. West. I am glad for one that this question has come up here. Being a farmer in the Connecticut valley, I am personally interested in this fish business. Fish seems to be one of the important elements in our fertilizers. Most all of the fertilizer manufacturers use more or less of it in their compounding. The great trouble with most of them, so far as I have been acquainted with them, is that the manufacturers put in too much potash. That comes largely from Germany, and the nitrogen and phosphoric acid in those fertilizers have been very abundant. There is a farmer living down there, within fourteen miles of Buzzard's Bay, who has never heard of this product as a commercial affair, or of its value even. I was a little surprised at that. Now, up with us we have used thousands of tons of commercial fertilizers, and if the price of fish goes up, nitrogen will probably be a little higher, and we shall have to pay more for our fertilizers. Now, if those millions of fish had only been caught last year, what a blessing it would have been to the Connecticut valley and the whole Commonwealth! So you see there are two sides to this question. I am glad it has been brought up here.

Mr. Bowker. I am aware that politics come into this question somewhat. Of course patriotic citizens are all sensitive about the rights of the Commonwealth; but, as I said to Mr. Russell, I do not care how that crop is taken out of the sea, whether it is taken under United States regulations or under State regulations, if it is only secured. Moreover, it is immaterial whether it is secured by a foreigner or by a citizen of our own State. The law should be such, in my judgment, that any citizen of the United States shall have the right, under certain restrictions, to go into the waters of any State in the Union and take these fish when they appear, for they are a crop to be harvested like a crop of hay, and I believe no one will be injured, but the world enriched. You cut your hay to-day, and if the weather is good you house it to-morrow. If you do not, it is lost forever. These fish come to our shores yearly; they are one of our annual crops; we take it to-day, and it is secured for the benefit of mankind. To-morrow it is gone, and that particular crop will never appear here again.

Now, I want to answer a remark made by Mr. Ware. I am surprised that any man should get up here and say that we want these fish preserved for sanitary reasons.

Mr. Ware. That is your own argument.

Mr. Bowker. I referred to the fact that they consumed the sewage of our cities, or rather the lower orders of plant life produced by sewage, not with reference to purifying the sea, but with reference to returning to the land the plant food which had been poured into the sea. Do you realize that three-quarters of the globe is covered with water? Those of you who have undertaken a trip even across the Atlantic know what a great waste of water there is, and that is but a bagatelle. If you have travelled across this country, you realize something the extent of it; and yet all the land of the globe is only one-fourth of the water. Talk about our preserving the fish along our shores for sanitary reasons! It's absurd. The sea-weed which is sometimes collected and used as a fertilizer is the food of all kinds of fish; they are supposed to eat more or less of it; but as to the fish purifying the beautiful sea in front of Mr. Ware's hotel, why, he might just as well attempt to purify it with germicides and a hand pump. It purifies itself through the action of the air and the sunlight.

I do not want, however, to narrow this discussion down to the simple question of plant food, but rather it is a question of food, either directly or indirectly, for man as well as for plants. Now, Huxley, the best authority on the subject, has stated, as I said in my paper, that, if it were not for the new and improved methods of catching fish, nine out of ten Englishmen could not afford to eat fish at all. Now, if we have got to have these new and improved methods wiped out in order to protect the hand-line fishermen, not only is the plant-food industry involved, but the food-fish industry as well. Cheap food, whether it is for man or plants, is what the world wants. You cannot get away from it, and our regulations, whether made by the State or the United States, should be in the interest of cheap food.

Mr. Ware. I made the statement that I did, quoting my authority.

Mr. Bowker. What was the doctor's name that you quoted in Boston?

Mr. Ware. I have not his name, but here is the Smithsonian Institute that you have quoted more than once, and you have said yourself that the menhaden were the scavengers of the sea, and that they lived upon the sewage that floated into the sea from Boston and other places. The whole thing is a perfect absurdity; I do not believe a word of it, any more than I believe that the menhaden come and eat sea-weed. They have not a tooth in their heads. They cannot bite off anything. They take their food by suction.

Mr. Bowker. You are quoting me wrongly.

Mr. Ware. No, I know that to be so; I have handled thousands of these menhaden.

Mr. Bowker. I did not say that the menhaden feed upon sea-weed proper, but there are certain kinds of fish that do feed upon sea-weed.

Mr. Ware. If you did not say so you did not say anything. The whole thing is absurd. This wholesale method of fishing is driving the fish away from our shores. It is a fact that I used to take them by hundreds of barrels right in my cove for fertilizing purposes without having to go through Mr. Bowker's mill at all, and now they are not there; and I say that if any legislation can be had which will operate to bring these fish back again within the three-mile limit, let us have it. But the idea of their eating the sewage of Boston is perfect nonsense, and the statement of that doctor from Boston was perfectly absurd. I do not know what his object was, but that statement was nonsense, and there is no foundation of truth in it whatever, in my opinion.

Secretary SESSIONS. I am sorry, Mr. Chairman, that the question which has been raised here has drifted into a personal matter or into a political matter, — into the question of State rights. I may be wrong, but as I understand it the State of Massachusetts forbids her own citizens catching fish in this manner just as she does the citizens of other States. The question is not in issue here whether the citizens of Rhode Island should be allowed to catch fish in the same way that the citizens of Massachusetts are allowed to catch them, but the question is whether the policy of Massachusetts in forbidding the catching of fish in this wholesale manner is the right system to be pursued. It seems to me we ought not to allow this matter to degenerate into any other question than that; that is, the question whether our policy is correct in forbidding fishing in this wholesale manner, not as to whether we shall allow the citizens of Rhode Island to catch our fish, or whether fish eat up the sewage, or anything of that sort. That may be a minor question, and may modify it somewhat. I do not like to see this personal feeling manifested when there is no cause for it at all. The question is a fair one, of course, whether the United States shall be allowed to police our waters, or whether Massachusetts shall do it herself; but it seems to me that if the policy of Massachusetts is wrong in this respect the place to go for a remedy is the Massachusetts Legislature, and if the Massachusetts Legislature can be made to believe that the State has made a mistake in this matter the law will be changed. If Mr. Ware believes there has not been any mistake made, he has just as good a right as anybody else to present his views there, and if he can convince the Legislature that he is right, the law will remain as it is. But, as I say, there is no question of State rights here.

Mr. JOHN BURSLEY (of West Barnstable). Coming as I do from Cape Cod, it may not be out of place for me to give a little personal experience with fish, — not with the menhaden, but with the herring. They have frequented a stream which borders on our place in greater or less numbers for years. The catching of them in that stream was prohibited by private laws for twelve years prior to 1886 or 1887. They had then bred in great numbers there, and people were allowed to go there for two or three years, when they were taken in large quantities for bait and shipped away, some five or six car-loads a year. In 1889, I think, or in 1890, provisions were made for taking another crop, but the catch was comparatively small. Whether that goes to prove that the wholesale catching of them had anything to do with their reduced numbers, or whether it was owing to some of the unexplained reasons which Mr Bowker has told us about, I cannot say, but certain it is they did not appear after they were caught in such large numbers.

With reference to the fishing around Buzzard's Bay to which the speaker alluded, there is a general belief — whether it can be backed up by scientific research I am not prepared to say — that the food fish are being driven away by the wholesale catching of menhaden and other fish of that sort. Whether it is true or not I do not pretend to say, but I know that the belief obtains among those shore fishermen. I am not a fisherman myself, but I know there are those who feel very much aggrieved thereby.

Mr. Bowker. It has been said here that we had certain rights as a colony before we went into the Union. I admit that, but I want to ask if we did not relinquish certain rights when we joined the Union? Was not the Union formed for the purpose not only of self-protection but of development on certain lines? Who improves and protects our coast? Who dredges out our bays and rivers? The United States. Who pays the bills? Every man in the country. And every man in the country has a right to the fish in the sea as well as the shore along the sea, whether he lives on Buzzard's Bay or in Tennessee.

The Chairman. The meeting now stands adjourned. When this subject is brought up before the committee of the Legislature I hope you will all be there.

Afternoon Session.

The meeting was called to order at 2.20 by Secretary Sessions, who said: It is time the exercises began. The presiding officer this afternoon will be President H. H. GOODELL, of the Massachusetts Agricultural College.

A number of persons have expressed a desire to visit the large shoe shops here. I am desired to give notice that to-morrow morning, at half-past eight, if they will meet at the office of Mr. Prouty, right around the corner, they will be shown through his building.

President GOODELL. When Mr. Cornell founded that great university in New York State, Cornell University, he stated his purpose in this broad and liberal way: "I would desire to found a university in which any person can gain instruction in any branch of knowledge." Pursuant to that plan a chair of agriculture was established there, and it is one of the most important in Cornell University. I take great pleasure in introducing to you this afternoon the gentleman who holds that chair, — one whom we have come to look upon as one of the fathers of agricultural education, one whose pupils are known far and wide by the good and thorough work they are doing, and one who is now clinching his instruction in the recitation room by practical work on his own farm. I take great pleasure in introducing to you this afternoon Prof. I. P. ROBERTS of Cornell University.

Professor ROBERTS. Mr. Chairman, you cannot imagine the thankfulness that I experience in standing before you to-day. This very kind introduction which you have given me, this very hearty reception from your farmers, who know probably more about agriculture than I do, — at least in many of its branches, for no one mind can compass all, — is very gratifying to me. When I look back to my first reception on a public stage in New York, it makes me feel that we are making advancement, and I feel rejoiced, I feel thankful; for, Mr. Chairman, the first time I appeared on a stage to deliver a public address in the State of New York, coming as I did from a Western college, I naturally supposed that the good people of New York were far advanced in intelligence, and it behooved me to gird my loins like a man and acquit myself and the university which I represented most creditably; and so, brother farmers, I selected this subject, "Better Buildings and Warm Water for Dairy Cattle." I wrote a very learned, as I thought, and a very practical disquisition upon that subject, and they hissed me off the stage. They made it so hot I could not stay there. That is literally the fact. The Hon. Harris Lewis, a man whose memory I respect and whom I respected greatly during his lifetime, got up and in that inimitable way that was all his own wanted to know, when I said that the cows at Cornell University drank sixty pounds of hot water a day, if I kept the *boiler* breed of cows up at Cornell. Well, you are not particularly interested in that, only as a little historical matter. Eleven years from that time I went to the same town and delivered the same address before the State Dairymen's Association, and they all rose in their places and voted me one of themselves. They wanted to know how we warmed the water for our cows; how much it cost per cow a day; how we secured the warm stables we had; what was the cheapest method, and it all went down, after eleven years, just as easy as could be. And so, sir, I want to say that, while steam and electricity have brought the balance of the world a long way in its march of civilization, the farmer has kept pace. I do not want to hear any more about the farmer lagging behind. Sir, two highly paid professors, holding full professorships in Cornell University, last Saturday lectured to a body of men about this size, and tried to show them by churn and table how to make butter. That is advancement. Those professors did not feel that they had lost their dignity in undertaking to teach those farmers how to make butter, and they were anxious to learn. I say that there has been advancement, and greater advancement among the agricultural classes than among almost any other in the land.

THE VALUE OF BREEDS AND VARIETIES,—HOW THEY ARE FORMED; THE EFFECT OF FOOD ON BREEDS.

BY PROF. I. P. ROBERTS, ITHACA, N. Y.

In judging of the value of breeds and varieties one should have some knowledge of how they are formed, if any distinction whatever is made in the quality of the breed or individuals of it. All breeds, so far as I have been able to discover, have been formed in a similar though not identical manner. First environment produces variation for the better. A mild climate or rich herbage or barren land produces changes in some particular localities which were quickly discovered by the most observing breeders.

As the wants of man multiplied and civilization advanced, advantage was taken of the improvement which was due entirely to environment, and selection was added, and so the foundation of improved breeds was laid. The breeder, if he was worthy the name, saw clearly that improved conditions had improved the animals of the foundation stock which he had selected; so he is led to secure still further improvement, by not only improving the surroundings but the food and care as well. As this improvement goes on, some individuals show the effect of it more than others, or they respond more quickly to their changed surroundings. Again a few of the best are chosen, and the work of forming a variety and later a breed is begun in earnest.

The value of the breed will be contingent upon two things. First, the quality of the foundation stock first selected, and the skill of the breeder. One of a breed may develop faster than the others, as also may the stock of one breeder become better than that of another, though not of the same family;

or the cattle of one breeder may be far worse than another, and so it is not an uncommon thing to find pure bloods of far less value than mixed bloods.

Soon the breeder writes the history or genealogy of his stock, and this we call a pedigree; but usually this pedigree gives us no light as to the performances of the animal. It only tells of sires and dams, grandsires and grandams. We have done a little in the right direction by publishing the performances of individual animals and families in a few cases.

If the foundation stock has been well selected and the breeder has been skilful, then the breed becomes valuable, because the qualities desired have been secured and made reasonably permanent by causing these qualities to be constantly active. Growth, it should be remembered, comes from the activity of molecules of matter, the new replacing the old; and, if the new particles are provided faster than the old are worn out, we have growth and surplus.

Let me repeat that the value of the breed or family is contingent upon the foundation stock and the skill of the breeder; if both have been superior, then the breed or variety has the qualities wanted. If dairy cattle, then no dairyman can afford to spend a lifetime in trying to form a breed, but should avail himself of the results secured by the successful breeders who have preceded him.

How They are Formed.

Since the strictly pure-blooded animals are usually high priced, and since no breed can fit perfectly into every condition on but few farms, and since an infusion of the mixed-blooded cattle of any locality is likely to give stamina and vigor to the pure bred, and some of the qualities best suited for the particular locality, therefore it is safe to advise each farmer to breed a *variety* of animals to suit his particular locality and wants. He should start with the best of the animals already on the farm, on the dam side, because these of necessity have in time adapted themselves to the food they have received, the land upon which they have grazed and the uses to which they have been put. It is not good policy to introduce animals of different characteristics and qualities, without very good and sufficient reasons. Success lies always in improving that which is already at hand; and I know of no better way than to unite the success of the plain farmer, with his plain-bred cattle, to those of the more skilled breeder of well-bred animals.

To the man who knows how to use them, the pure breeds are of inestimable value. To the man who is constantly improving his animals, success comes quickly and he finds that he is not only possessor of grades and of valuable families, but also of many varieties of cattle, sheep, swine, etc. To this improver of domestic animals the pure bred is a necessity if he would accomplish his purpose quickly and cheaply. The pure bred to the man who has plenty of money and little experience is a snare. To the man who has little money and little experience, a *variety* of animals is better than pure bloods while he is learning.

Since all breeds and varieties have been formed by steady and slow advancement, so valuable qualities in any breed, variety, family or mongrel animals must be secured by the same slow, painstaking process. The plebeian animals can easily be raised in a few generations to the dignity of varieties, and some of the best specimens will form as good foundation stock for new breeds as formed the beginning of the breeds which we already have.

The United States needs a far greater number of breeds, the farmer needs an infinite number of varieties, in fact, every farmer should have a variety of cattle all his own, suited to his pastures, his feed bin, *his skill*, his climate and the purposes to which he desires to put them. Writing and publishing a pedigree does not make a breed or variety; they can be formed by selecting the best, not only for the foundation stock but by making constant selections; that is, by regularly weeding out all animals except the superior ones. These in turn are improved by improving their food and surroundings, and by better and more intelligent care and use. They are not formed quickly, but are the product of long and intelligent effort. There are no secrets and there are no miracles, and I am surprised that there are not, after so many years of breeding pure-bred animals, more varieties, breeds and sub-breeds, each adapted to its particular locality and conditions. Success lies along this line, and it cannot be well secured on any other.

The Effect of Food on Breeds.

Darwin says that "of all the factors which produce variation in animals, food is the most potent." Food is also the greatest factor in producing improvement; and, if we are aiming to improve animals, of course we are ever trying to produce variation, for if no variation occurs then there can be no advancement. Starting from these fundamental principles, we may now begin to treat of the details of the feeding and care of the animals, in order to produce variation for the better, or variation which shall result in fitting the animals more perfectly for some specific use or uses.

In order to illustrate, I take the improvement of dairy cattle. Start with the parents; if, at or just before the time of conception, the parents are fed and cared for as we usually treat the best of our beef breeds, then we have taken one step towards variation for the worse, because a new quality, beef, is being introduced into the blood of the embryo, and we cannot hope to get as good a dairy calf as we would had the sire and dam at the time of copulation been in a condition in which all dairy cattle should be kept. From the moment the calf is born it should be watched and trained for the dairy as carefully and scientifically as is the little foal that is dropped in the trotting stable. It has been discovered that, in order to get the best results, trotting colts should be fed and developed towards the uses to which they are to be put when mature. They are not only fed with a view to the track, but they are also exercised with a view to speed. Should the trotting colt be fed like the draft colt, then we might expect marked variation to appear before maturity, and this marked variation for the worse; and, if a trotter were desired, this would be a very foolish and very unscientific method of treating a trotting colt. I use the trotting colt as an illustration, because of the scientific treatment and breeding which is showing such marked results, since the colt has been properly bred, fed and exercised.

If the dairyman were to use a tithe of the skill in rearing the dairy calf that the horseman shows in rearing the trotting colts, we long since would have doubled the average product of our dairy cattle. Taking the dairy calf at birth, we find that it is unable to digest and assimilate coarse or innutritious food. Its delicate digestive apparatus can only take care of those forms of food which are easily broken down and assimilated, such as new milk; but, if the calf is fed with new and rich milk, it is soon inclined to put on fat, and this is just what the dairyman does not want. He should teach his animal to put fat in the pail and not on the ribs; and so the utmost care must be taken in so balancing the quality of the food and the quantity as to produce vigorous, healthy growth, and to extend to some extent the abdomen without inducing the young animal to store up tallow. Great care should be taken not to have the food so concentrated as to dwarf the viscera and contract the stomach, and neither should the food be so innutritious as to distend the stomach to such an extent as to injure the power of digestion and assimilation. We find calves can be reared on whey or watered buttermilk; but the results are not satisfactory, because the calf must take into its stomach so great a bulk that it cannot take care of it, and hence bloating, colic and indigestion are sure to follow. The dairy calves should never be fed largely on concentrated food, such as corn meal, cotton-seed, etc. If they lay on some little flesh and even some fat while on pasture, no evil results will follow; but flesh and fat laid on by the feeding of concentrated and heat-producing foods are sure to affect the usefulness of the future cow.

The calf, like the trotting colt, should begin its life work very young. At first thought it would appear that the calf should be matured before it was allowed to produce young, because it seems somewhat contrary to our theories, at least of vigor and reproduction, to copulate immature animals; but in practice it is found that the young heifer must be set at her life work at a very early age, and, as she does not give milk, or it is not practical to have her do so before she drops a calf, it is the practice, and a very wise one, to have her drop her first calf at not more than two years of age. While this calf is in uterus she is of necessity if well fed somewhat fleshy, but this flesh should rapidly disappear if she has the dairy instinct, as soon as she begins to produce milk, and this first year of the dairy calf-cow is the most critical one of all her life. Immature, because not more than half grown, she has had to give life and sustenance to her calf, she is now called on to give milk for her owner, and within a few months she will again have to furnish life and sustenance for her second calf; so here is a constant threefold demand upon her energies, and unless the utmost skill and pains is taken, the usefulness of the coming cow can be almost ruined by careless and ignorant methods. This young heifer should not only receive a great abundance of food, but that which is succulent and easily digested. The greatest care should be taken to make her develop the mammary glands; that is, her food should be so regulated that it would not only sustain her and produce material for the growth of herself and the embryo calf, but also a large surplus, because the milk and butter product is merely the surplus, or what is left after the other wants have been supplied. If scarcely more food is given than is required for the life and growth of the animal, then of necessity little surplus product will be secured, and what is produced is often secured at the expense of the young cow and her prospective calf. I wish I knew how to emphasize the need of a more scientific and practical treatment of our two-year-old heifers. If all of them could be fed right for one or two generations, the average product per cow of our dairies could easily be raised twenty per cent.

Now, I should like to give some little time to the effect of food on the dairy, etc. I have left purposely the far-reaching effects of feeding, on the product of the animal particularly, for general discussion, rather than to try to cover the whole subject. I only want to say, before I take my seat, that I believe that you, like I, will enjoy yourselves wonderfully in breeding a variety of cattle. We have two varieties of cattle. Summing up our results, we find that we have succeeded in more than doubling, nearly trebling, the average income per cow of our stables. We are trying to teach a lesson to our students. We are not doing it with thoroughbred cattle entirely, we are doing it almost entirely with grades, saying to the student, as he comes and looks through our stables and sees what is done there: "See if you cannot go home and do the same thing without drawing upon your father's bank account for four or five thousand dollars. You are too young to breed thoroughbred cattle; it takes long experience and skill to be eminently successful in breeding thoroughbred animals. You want to commence on your father's farm, first taking out the poor cows; second, selecting the best ones; and third, taking advantage of the successes of the ages that have gone before, — the successes of the island of Jersey, the successes of Holland and the successes of your immediate neighbor. Gather them all up together. It is a good deal cheaper to buy these successes than it is to go over the ground." That is my opinion, but it is the opinion of only one man, and one man's opinion, although he may have had a wide field of observation, although he may have been long a teacher, although he may have been successful, — one man's opinion of necessity is restricted. So I would like to hear this intelligent audience discuss this subject among themselves rather than ask questions, because I came here to learn rather than to teach.

The CHAIRMAN. The question before you this afternoon is "The value of breeds and varieties, the formation of breeds and varieties, and the effect of food on breeds." These questions are now open before you.

Mr. LYNDE. Professor Roberts has made a statement to the effect that we should have greater varieties of breeds, and I apprehend that this audience would like to have him tell us what he means by "greater varieties." I think he is generally misunderstood by the audience.

Professor ROBERTS. I mean that you should take as the foundation of your stock the best of the cattle that are in your stables, to commence with.

Mr. LYNDE. I do not think the audience thought you meant that. That is the very reason I asked the question, that you might explain yourself.

Professor ROBERTS. I am very thankful to you for calling my attention to it. Begin with the best cows you have in your stables, then take a thoroughbred sire, — by that I mean a male from some herd where some noted animals are found in the line of their pedigree. Coupling such a sire with a good cow, we get a seven-eighths, a fifteen-sixteenths and a thirty-one thirty-seconds. I think when we get there we may call them a "variety" of cattle. I should drop the word "grade" when they have reached that point.

Professor CHEESMAN. I would like to have you give some further information in regard to that thirty-five-dollar cow that you mentioned. Won't you tell us what her condition was when you got hold of her, how much she weighed, what she cost you to keep her during the first year when she gave that four hundred and forty pounds of butter, and how much she is giving to-day?

Professor ROBERTS. The cow was one of two that were picked out, supposing they would give us a fair amount of milk. We had two purposes in view. One was to show our students how the dairymen of New York kept their cows, or how they did not keep them. The other was, we wanted more milk than our cows would give. We sell considerable milk, and use a good deal for laboratory work with our students. This cow looked as though she might have quite a sprinkling of Shorthorn blood. That was her appearance; I know nothing of her history. She failed to produce young the next year, and so we milked her about eighteen or twenty months, and she has gone to the butcher. She would weigh when we got her about eight hundred pounds; when we sold her she would weigh about eleven hundred pounds.

Mr. RICHARDS. I cannot quite understand the professor when he speaks of "variety." I do not know what he means by that, — whether he means that he would not have farmers introduce thoroughbreds and continue that line, for instance, Jersey, Holstein, etc. Most of you probably know the record of "Jersey Belle," owned by Mr. Charles O. Ellms of Scituate. Four or five years ago she was the most famous cow then in America. Her owner was offered twenty-five or fifty thousand dollars for her. I have a descendant of that cow, and there have been many, of course, round about in our neighborhood. You know, perhaps, that her record was twenty-four and a half pounds of butter a week. That of course is exceeded now, but eight or nine years ago that was the highest record, — over three pounds of butter a day. That was a chance cow, it was not a thoroughbred. She was raised in Hingham, and he obtained her because her mother made very yellow butter in the winter, and that was what he wanted; so he procured a calf from that cow. The daughters of that cow give a large quantity of milk and considerable butter, but nowhere near the amount that the mother gave; the blood seems now to be more or less passing out. There is hardly an instance, I think, where the record of one of the daughters comes up to that of the old cow. So it seems to me that the professor's theory about breeding from varieties and not from thoroughbreds, as Jerseys, Holsteins, etc., will not hold good.

Professor ROBERTS. I suppose those who are familiar with a large number of Jersey cattle know that a great many of them are not very valuable. We always appear to like to talk of a few herds and of the best animals in those herds, and somehow we put out of sight the poorer ones. That is a mistake, because I have not a very great respect, it is true, for a man who lies to me, but I have far more respect for a man who lies to me than for one who lies to himself. Now, farmers, we are seeking after the truth, and farming in many lines is pretty hard work, and a part of it is our fault. It is not the fault of politics, nor of the Republicans, nor of the Democrats; it is our fault, because, as I think, we have not made as good use as we ought to of our land, of our markets and of our cattle. I come to you to-day in all earnestness, asking you, as I ask the farmers of New York, to see if you cannot put a little more brains into this business. Here is the president of your college; he asks you to send your boys there. I guess you are going to ask him for a winter course of lectures such as we have had. Now, what does that mean? It means that the colleges have brought their teaching to the farmer, and it means, if it means anything, that that teaching is worth something. Now, you have got that instruction for your boys here in your own State. My friend the secretary has sent for me, kept me away from my boys for two days, and agreed to pay my expenses and so on, to come here and do the very thing which I shall do to my boys. This is a college, to all intents and purposes ; it is a university extension. And so I say again, that this land that you have here is not very poor land, only you have not somehow got hold of it right. Your land is better than you think it is. I know it to be so, because when I can take an old clay pit at Cornell University that was supposed to be run out, and raise more than twenty-four bushels of wheat per acre on it for three years in succession, without any grass or clover intervening, or any fertilizers or any farm manures, I know that there is the same fertility in your land, and I know that first-class culture will get it out. I know that you have the foundation for the best dairy animals in the world right here in this State. I know that some of our records in this State have beaten any of the records that have ever been made in Europe. If I am wrong, correct me. I know that you can not only perpetuate the Jersey cow, but you can make better butter than the Channel Island men ever saw. I know that the plain farmers up on these Massachusetts hills can have heavier bank accounts than the farmers of Jersey have. I refer to the Jerseys because we have started out with them, and probably that breed is better adapted to this climate and to these conditions than the Holstein. I think very likely that is the case, but I do not know it to be so. Now, I say that every farmer on these pleasant hillsides can go home and take advantage of the good animals that he has in his stables, discarding the others, and have a variety of Jerseys that, if they are well bred, will equal an average thoroughbred Jersey herd. I say to-day, and I say it publicly, that I have a herd of grade Jerseys that I will pit against the *average* production of the thoroughbred Jersey cattle, — not against the best of them. I have a herd of grade Holsteins, or a variety of Holsteins, bred by myself there for illustration, that will excel the average production of all the thoroughbred Holstein cows. Some of the cows I started with gave less than three thousand pounds of milk a year, and I have got an average from both herds of over eight thousand pounds per cow a year. I have Holstein grade cows that when I came away the professor of dairy husbandry said they had crossed the ten thousand pounds limit, and the year is not yet up. We have several Jerseys that have given over six thousand pounds, — plain farmer cows, bred there at the university. But there is not a farmer in this audience who cannot beat me all to pieces if he will try. Now, that is saying a good deal, is it not? Let us be honest. I want to confess to you that you can do infinitely better than I do. Most of you men are at home, and can take part in your farm affairs: but I am an executive officer, and engaged very largely in executive affairs. I have not milked a cow for ten years, I think; I do not know that I have bought a cow for ten years, and often a week elapses that I do not get into the barn. I have had to work out these problems at arm's length. I have had to take care of boys instead of calves and cattle, and I do not hesitate to say that there is not a gentleman resident in this Commonwealth of Massachusetts to-day who cannot go home and do infinitely better than I have done. I say the reason you have not done it is because you have not made the best use of the opportunities you have had. You want more such meetings as this, more such men to talk to you just as you have been talked to at these meetings, and somehow get up a little more enthusiasm. You can do it. These fields are not worn out. You have good lands, good cows, and you ought not to have any poor ones.

Mr. LYNDE. I think part of the audience, at least, have misunderstood the professor. He has said that a mixed herd is better than a thoroughbred herd. I think there are many of you who understand him to say that he would not breed from a thoroughbred sire. I think that is a mistake. I think he would not give you any such instruction as that, but that he would have you breed from a thoroughbred sire, but he would have you take the very best of the dams that you find in your stables. I think the speaker and the audience should understand each other better.

Professor ROBERTS. Does any one else in the audience understand that I have recommended breeding from any other than a thoroughbred sire?

Mr. LYNDE. I think many of the audience so understand it.

Professor ROBERTS. If I had been so understood, you would have had my hair off by this time.

Mr. ——. We would hiss you off the stage.

Professor ROBERTS. Any man who would not take advantage of the knowledge and skill of the best breeders in the world, when a male calf can be bought for fifty dollars, and a pretty good one, too, ought to be hissed off the stage.

Mr. MILLS. Would you not avail yourself, if you could, of just the same condition of things, namely, a thoroughbred animal on the dam side? That is, would you advise farmers to avail themselves of grade animals because we must, or because it is best? I would like to have that question answered.

Professor ROBERTS. I would not advise you to buy those thoroughbred animals, females and males, because you are not skilled enough to breed them yet. I have seen hundreds of men undertake to breed thoroughbred animals, and the animals that somebody else produced were a good deal higher than they were, and consequently their thoroughbreds sank down to their level, and that is the grade level. That has been the course of the thoroughbreds. They have gone into the hands of men who were not large enough to handle them, who had not the nerve to get rid of a calf that was not a good calf, if it did have a pedigree a yard long.

Now I come back to what I did say. I said that a man who produced a thing himself prized it a great deal higher than if he purchased it. That is what I said, did I not? Now, the animal that you go out and buy is liable to repeat the old story. If it drops a calf, that calf does not give half as much milk as its dam did; her calf does not give near as much as the dam did, and so on. More than that, you know that the thoroughbred animals, if they are kept up to their standard, must be fed with the utmost skill, and they must be fed liberally. Now, don't you forget that the man who is not used to handling thoroughbred stock fails. He had a good deal better learn his lesson with cheaper material. When I send my boys home I say: "The last thing you want to do is to ask your father to put thoroughbred females in the dairy. When you have learned to breed a good variety of grade females, then is time enough to ask your father for money to buy a thoroughbred female. You can switch off from breeding grades onto breeding thoroughbreds so easy, but it is an awful thing to switch from breeding thoroughbreds to breeding grades. It is a wrong kind of a switch; it is a switch back."

Professor CHEESMAN. Before we close this subject of breeding, I want to ask further, so that we may all understand it distinctly, whether these cows that the gentleman speaks of sometimes as Jersey grades, at other times as varieties, have been crossed with Holstein bulls; and the same with reference to the Holstein grades? Have you bred up with a thoroughbred Jersey bull, or with a thoroughbred Holstein bull right through?

Professor ROBERTS. We take a native cow. By a native cow I mean a cow that has been bred to no purpose. Sometimes we found a native cow that had some Shorthorn blood. Sometimes by the twist of the horn you could see evidence of a little Ayrshire blood, sometimes a little trace of the Devon blood apparently, in what we would call a scrub cow. We tried to get good ones. We could not always get the best cows; our condition was such that we could not avail ourselves of the best; but, as I say, we tried to get good ones. Now, when we started in with a Jersey and got a half-blood, we kept on and got a three-quarters, a seven-eighths, a fifteen-sixteenths, a thirty-one thirty-seconds, and so on.

Professor CHEESMAN. How much increase in size have you got since you commenced breeding grade Jerseys?

Professor ROBERTS. I should say we are breeding Jerseys that are fifteen per cent larger than your New England Jerseys, but not much larger than the Miller & Smith Jerseys of Franklin, Pennsylvania. You know they are breeding large Jerseys, and I like that. Then we have taken pains to breed the Holstein down. That gives you an inkling as to my ideal of a dairy cow, does it not?

Professor CHEESMAN. What do those cows weigh that have passed the ten thousand pounds limit this year?

Professor ROBERTS. Those cows will average at least twelve hundred pounds. They are in good dairy flesh.

Professor CHEESMAN. How much do the six thousand pounds Jerseys weigh?

Professor ROBERTS. I can hardly tell. We weigh them pretty often, but I am not the professor of dairy husbandry.

Professor CHEESMAN. Can you not tell us within fifty pounds?

Professor ROBERTS. I guess I can if I think a little. You know sometimes we have a little two-year-old thing which reduces the average. You want the weight of the mature cow; I think our grade Jerseys will average pretty near nine hundred pounds.

Mr. WATERS. I would like to ask the professor how much grain he fed that cow that made four hundred and forty pounds of butter a year?

Professor ROBERTS. Eight pounds a day is our general rule to a cow giving a large amount of milk. A little more is given to a cow that is going into beef, but our rule is eight pounds of concentrated food per day per cow when they are in milk. That food is generally composed of about one-quarter cotton-seed meal, one-quarter bran, and the other half oats or corn or anything we can get.

Mr. WATERS. Is that the ration that you feed to your grade Jerseys?

Professor ROBERTS. Yes, sir; eight pounds of concentrated food a day when they are in milk. Now, mind what I said. If we see a little Jersey cow, for instance, whose capacity is not up to that feed, and she begins to go to beef, we withhold a little. She has got a surplus, she eats more than her udder will take care of, and she is going to put it on her ribs. We do not want her to do that.

Mr. ——. This is a milk-producing country. Now, would you advise a man starting in the milk business to start off with a herd of grade Jerseys or grade Holsteins? From which can he get the most profit, compared with the food they will consume and the milk they will give?

Professor ROBERTS. I would advise such a man, the first thing he did, to go and learn how to judge a dairy cow. He can go to the college and learn it this winter. He can get more information there than at any other place. If he will come up to our place, our professor of dairy husbandry will give him a few simple lessons on how to select a dairy cow. That is the first thing. Then he can go out and buy his females from the cows of the country. If I were such a man, I should pick out good, strong young cows that promise to give a large amount of good milk. Then I should purchase a first-class male Jersey, in this locality, and then I would show my neighbors that I knew something about the process of breeding, and breed a herd that I would be proud of.

Mr. Myrick. Would you do that if you had to sell your milk for two cents a quart?

Professor Roberts. I would not sell milk for two cents a quart, if I could avoid it. Yes, I think I would.

Secretary Gold. Do you find the half-bloods better than after you have bred them still higher?

Professor Roberts. Well, I am sorry to say that I could not answer that question unless I had our tabulated statement here. If I had our record before me, I could tell you in a moment.

Secretary Gold. Without any special record, but with some miscellaneous practice, with one continuous line running through it, however, the result with me has been that the half-bloods were better generally than the higher grades. I started with a miscellaneous herd. I selected thirty or forty cows, put on a Shorthorn bull from an excellent milking family, and I raised my half-bloods, three-quarters, seven-eighths, and so on; and presently my neighbors suggested that my stock was getting too large, and that perhaps I might improve by some other variety. In the mean time I had some pure-bred Shorthorn females also. I put on a Devon bull, and bred grade Devons (I had some pure-breds, too) until my herd were all alike. I got some of the nicest grade steers that you can imagine. The cows were all red, and there was a little inconvenience, because some of them were so much like others that we could not tell one cow from another. So we selected an Ayrshire bull and some pure-bred cows also, and we bred Ayrshires until every animal in the herd was as spotted as those that Jacob had. Then we got the idea that probably the Holsteins were the coming cows, and we put on a Holstein bull until black and white were the prevailing colors. In the mean time we desired to go into the creamery business, and we found that we could not get much cream from the Holsteins, but must go to the Jerseys and Guernseys; and so we are now putting in stock of that kind, and also buying some of the chance Jersey stock that you referred to that are no better than they should be. Somebody else wanted to dispose of them, and we unfortunately were induced to buy some pure-bred Jerseys of that quality. We are now raising from ten to twenty heifer calves a year, and putting them into our dairy. We have not kept a record of the yield, but we have this impression very clearly in our minds, that the half-bloods that we got the first two years after we introduced a pure-bred sire were better animals than the stock that we graded higher, whether Shorthorn, Devon, Ayrshire or Holstein. We have not carried it far enough to see what the result will be with the Guernsey.

Mr. Ware. Which blood, on the whole, satisfies you best?

Secretary Gold. That is a question which I am not prepared to answer.

Mr. Lynde. I would like to ask Mr. Gold if he would recommend to the young farmers here the promiscuous breeding that he has gone into?

Secretary Gold. I do not recommend it at all. I am speaking of it as one of the wild vagaries that I have followed through my life, and if anybody can draw from my experience any rules to guide them, I would like to have them do so. I am all at sea about it.

Professor Roberts. I am glad to hear Mr. Gold's experience, because it justifies me, I think, in the advice I give my students. It is something like this: "Try to find out, before you enter the business of raising cattle, what class of cattle will best suit your conditions and your tastes, for a man has no business to breed Holsteins if he likes Jerseys, or *vice versa*. Having done that and got started, then if it is not the best breed make it the best." That is my notion.

Now, you have struck another principle that we observe in plants particularly, and which may hold true with animals, that the first cross sometimes gives vigor, so that the wise corn-planter often takes a few kernels of one variety of corn and mixes them with some other variety, so that the pollen from the new variety will come onto the old and stimulate it to greater production. I am rather inclined to think, Mr. Gold, that there is something in what you have said with regard to animals, — that the first cross is apt to stimulate production sometimes more than would appear on either side of the house, in the dam or the sire.

Now, another point, and then I am through with what Mr. Gold has said. It is quite possible that in all your efforts you have not studied the law of the dairy calf; that somebody produced those animals, and produced them fairly well; then you took them, and as soon as you began to raise calves you broke the law of the dairy calf, and the result was, that the longer you continued the cross the poorer your animals became. That often happens.

Secretary GOLD. I would say that my system of breeding was not quite so wild as you might consider it, because the conditions varied through all this period very much. When we were seeking to breed Shorthorns, beef was a very important production; very soon Devon steers were in demand, and Devons suited the market at that time; then came shipping milk to New York, and the Ayrshire came in to meet that demand and call; and now, making cream for a creamery, we demand still a different class of cattle; and this is what has led me largely to pursue this course. There are few farmers who can speak from an experience of fifty years, keeping their own stock straight along, as I can; but these different conditions induced me to look for different classes of animals.

Mr. APPLETON. I feel sometimes a little bad, as if I pitied the United States, and for this reason. We have been talking here to-day about the cattle on our farms as Jerseys, Ayrshires, Holsteins, and so on. I would like to ask the professor, if we continue the system of breeding of which he speaks, when he thinks we can speak of "American cattle" or "United States cattle"? As you referred to sheep in that same way, why should we not in time have something we can call our own?

Professor ROBERTS. I think we will. I have advocated this for a year or two, and have taken hold of it, and you are going to take hold of it. More than one man in this audience will go home and see if he has not got the material on his farm for the foundation, and all it lacks is the skill to unite the proper blood. That is all Charles Colling did, and all that Robert Bakewell did.

Mr. Appleton. It seems to me that your words need to be enforced upon the farmers.

Question. How are we to enforce them?

Mr. Appleton. Simply by bringing before them, "line upon line and precept upon precept," such instruction as we have had here, in order to bring about the desired result. I think this Board has adopted a method which has that object in view. The Board is going to institute lectures on this same subject in different towns throughout the State. If we could have your lecture repeated, it would be a great help. I refer to this to show that the Board is progressing and doing more than it has in the past by having these lectures during the winter. I think it is an advance and will be a great help. It was to make that point that I rose and asked the question.

Mr. McIntosh. I wish to say one word to help out Mr. Gold. I am one of those old fogies who still cling to oxen. I have learned that in Connecticut they still produce a good many working oxen, and there are some men who make it their business to buy oxen wherever they can find anybody who has a good yoke to sell. That is the reason they breed steers there. In Massachusetts oxen have gone out of fashion except among a few old fogies.

Secretary Sessions. Mr. Brooks, the professor of agriculture at the Massachusetts Agricultural College, I think could tell a little story about his experience with some grade cows which he purchased, that may be of interest as showing the ability of New England cattle to furnish something to build on.

Professor Brooks. I will say that, at the time when I took charge of the herd of cattle on the college farm at Amherst, the barn was not nearly full. I found the farm producing an enormous quantity of fodder, corn, etc., but no stock to consume it. The policy had been pursued for a few years of selling a good deal of hay, and many of the fields on the farm needed an additional amount of fertilizers.

I therefore thought it would be best to fill the barn with cows. We could dispose of any amount of cream in the local creameries, and the cows would consume the fodder we produced. I accordingly set out with my farm superintendent and picked up twenty new milch cows. This was in October, 1890. We saw a considerable number of cows in order to select the twenty, and I will leave you to judge whether we got good ones, when you hear what the twenty cows did.

QUESTION. What did you pay for them?

Professor BROOKS. We paid on the average about fifty dollars. We put those cows at once into our barn, and fed them liberally. We had ensilage made from a variety of corn that ripens, and it was very full of grain. We gave about thirty or forty pounds of this a day, and in addition to that gave some corn stover during part of the winter, and as much hay as the cattle would eat, with mixed grain, consisting of bran and cotton seed, the greater part of the time. The daily gross cost of the feed was about eighteen cents per animal, but after deducting the manurial value of the food, as Dr. Goessmann would estimate it, the net cost of feeding those cows was not more than nine or ten cents per day for each cow. We kept accurate records of our college herd, weighing the milk after every milking, and those twenty cows gave an average of a little over seven thousand pounds of milk, and that notwithstanding the fact that one of them was practically worthless, as she came down with foot-rot within a very short time after we got her, and contributed very little to the total. We also kept accurate records of the cream produced from this milk, and the average per cow gave a little over three hundred pounds of butter in the year. This butter is marketed in the shape of cream in the local creamery, and must have averaged us about eighteen or twenty cents a pound, as we get all the way from three to four cents a space, and it takes a little over six spaces to make a pound of butter. In addition to this, which would amount, I presume, to about fifteen or sixteen cents per cow daily for the butter, we of course had the skim-milk, which would be something like twenty pounds, or nine quarts, which for feeding may have been worth about six cents.

If we could have sold it, it would have been worth more. But this would make the proceeds from each cow something over twenty cents per day. Labor does not enter into this calculation, of course, but you see how it stands. Let me recapitulate. We obtained from the butter about sixteen cents; the skim-milk may have been worth six cents; making twenty-two cents. The gross cost of feeding was about eighteen cents, but the net cost, after allowing for the manurial value, was only about half that sum. So that there is quite a liberal margin to pay for labor, interest on the cost of the cows, and for depreciation.

Secretary SESSIONS. Tell us something about the breed of the cows.

Professor BROOKS. We knew nothing about the ancestry of those cows in most cases, but there was quite a variety. One of them we found out afterwards was a pedigree Shorthorn. We did not give anything more for her because she had a pedigree. They were good-sized cows, with Shorthorn blood in a good many of them; I should say grade Shorthorn had been the foundation on the maternal side, and that they had been crossed to a considerable extent with Jersey bulls, so that it was a mixture of our own native stock with some Shorthorn and some Jersey blood.

QUESTION. How many spaces of cream did you get per cow?

Professor BROOKS. In the vicinity of twelve spaces, as a rule. Professor Roberts has had something to say upon one point in regard to which I wanted additional information. He spoke of breeding a young creature so that she should produce her first calf at the age of two years. I judged from his remarks that he proposed to breed her again within a few weeks, so that she would have her second calf perhaps before she was three years old. I have not had much opportunity to test the matter in my own experience, but I had rather got the opinion that it would be better to allow a somewhat longer interval between the first and second calf, in order to give a young creature time to grow, and in order also to fix that very valuable characteristic of holding out giving milk for a long period; for I find that the profit depends very largely upon the length of time during which it will hold out. There is the greatest difference between cows in that respect. One of the worst things I have to say about Shorthorn cows from my own experience is that they do not generally hold out as well as some others. But I believe we can do very much to fix this quality, or to establish this quality by following the plan I have indicated. I would like to ask Professor Roberts what his idea is upon that.

Professor ROBERTS. We breed our cows at all times. We never lock up our dairy. Our dairy runs all the year round, Sundays not excepted. We think we can make milk better and cheaper in the winter than we can in the spring, so of necessity we try to breed a certain number of cows a month. We should breed this heifer about three months after she came in, if she will conceive at that time. If she is giving a fair amount of milk, then she is not likely to conceive, and we must wait a longer time. We usually try to breed them so they will have a calf once a year, so as to keep our herd good.

Mr. Geo. M. WHITAKER (of Boston). There is one subject that has a bearing on the dairy question which I would like to inquire about. For years there has been a good deal of discussion and agitation over the oleomargarine question, and at hearings before legislative committees and elsewhere the farmers of the State have been opposed by money men who have told us that the legislation we asked for was wholly unreasonable, because oleomargarine was a valuable food product, almost identical chemically with butter. They said it was just like butter, except a few unimportant volatile oils. Now, the professor in talking about volatile oils led us to think of them as natural stimulants of digestion. I would like to ask his opinion whether or not those few volatile oils which chemists have alluded to in those hearings as so unimportant may really constitute very valuable elements, giving a digestibility to butter which does not exist in oleomargarine? That is a point I have never seen alluded to in any dairy discussion before.

Professor ROBERTS. They certainly do. This is not guess-work, but from actual experience. You have only to appeal to your own taste in regard to fruit and all kinds of food, to know that those volatile oils that come from well-developed fruit and well-cooked food are powerful assistants of digestion. There are many people, especially people who are somewhat aged, who cannot eat a piece of meat that has laid out on the butcher's table for a week. My cows, when they are well fed, will not eat hay that has laid out and been aired for two or three days on the floor. It has lost its spirit; that is, the volatile oil which stimulates digestion. The gentleman has made a good point there. The oleomargarine manufacturers understand this, and they churn the oleo with milk, in order to get a little of the volatile oil to assist digestion.

Mr. Moore. I would like to ask the gentleman whether they heat the water for their stock.

Professor Roberts. Yes, we feed hot water. The Bible says, "Because you are neither hot nor cold I will spew you out of my mouth;" and that is literally true, I think, with feeding cattle or with feeding men. You want your tea cold, or you want it hot, — I do. We water our animals during all the colder months with water at a temperature of about ninety degrees. They will drink it very comfortably at one hundred and ten after they get used to it. You can drink milk, or at least I can, at one hundred and thirty degrees. The cows relish the hot water, and if you ask some good physician, he will tell you that the effect of hot water in stimulating digestion is exactly the same as cold water. When you sit down to a meal and drink a glass of cold water your stomach is cold; presently the reaction comes, and then you are ready for your meal. You do the same thing when you drink hot water, only the action is primary instead of secondary.

Question. Can you tell us what per cent of milk you get with warm water, as compared with cold?

Professor Roberts. We have warm stables, and all the conditions are favorable. Our experiments during one winter when we gave our cows cold water showed a diminution in the quantity of milk of about fourteen per cent.

Secretary Sessions. Professor Roberts has argued to-day for variety in breeds. He has asked the question why he has been called upon to come here and give us instruction.

Has he not answered it himself ? It is *variety* that we want. The instruction he has given is the same that we have received from other lecturers, but it has come from him in a little different way. That is why we have asked the professor to come here to-day.

Adjourned to Thursday, at 9.30.

Mr. C. N. Prouty tendered a reception to the Board of Agriculture on Wednesday evening. His commodious and beautiful residence was crowded with the citizens of Spencer and surrounding towns, who came on invitation of the host to greet the Board. The occasion was in every way enjoyable, and was a very agreeable part of the experience of the Spencer public winter meeting.

THIRD DAY.

Secretary Sessions called the meeting to order at about 9.45, and said: We have been very fortunate indeed in our weather for this meeting, but to-day the skies seem a little forbidding, and there is considerable moisture in the air, yet I am very much pleased to see the number present, notwithstanding the forbidding weather. Our program to-day is of a different character from that of the past two days, and is somewhat different from what we have presented to the people at the meetings of the State Board in years previous; but it was decided upon with the idea that the farmers of the Commonwealth should be brought into closer touch with the State agricultural organizations, College, Experiment Stations, Cattle Commission and Board of Agriculture, and I hope the gentlemen present will feel at liberty to ask questions and make suggestions for the future conduct and management of these institutions.

The committee has asked Mr. W. W. Rawson, who is well known to you as a member of the Board for a number of years, to preside this morning, and I have the pleasure of introducing Mr. Rawson.

Upon assuming the chair, Mr. Rawson said: Gentlemen, It is rather unexpected to me to be called upon to preside at this meeting, therefore I have no preliminary remarks to make, and, as we have three subjects before us this forenoon, I think the best thing for us to do is to start in with the first one, which is, "Work of the Agricultural College and Hatch Experiment Station." We have a gentleman present, well known to you all, one who has been to foreign countries and brought home ideas to us. He is professor of agriculture in the college. I now take great pleasure in introducing to you Prof. William P. Brooks of Amherst.

Professor Brooks. Gentlemen, I heartily concur in what Secretary Sessions has said in regard to the desirability of bringing you into closer touch with the Agricultural College and Hatch Experiment Station, and in the further thought expressed by him that it is desirable that you should offer your criticisms and your suggestions; and it is with a view of drawing out such criticisms and suggestions I have written out what I have to say upon the subject. I might have preferred to speak somewhat extemporaneously; but the subject is so broad, there are so many things which might be said, and I was desirous of covering the ground completely, that I have thought better to write out what I have to say, in order that I might express myself the more concisely, and cover the ground more completely.

WORK OF THE AGRICULTURAL COLLEGE AND HATCH EXPERIMENT STATION.

BY PROF. WM. P. BROOKS, AMHERST.

The consideration of my subject naturally falls under two heads, — College and Station; and yet at the outset I desire to point out that these two are by no means entirely independent. I have gathered the impression, through contact with leading farmers throughout the State, that there is some misapprehension in regard to the relations of college and stations. The State Experiment Station is managed under an entirely separate and independent organization, and is supported by the State; but the Hatch Experiment Station, organized under the so-called Hatch act, is organically connected with the college, and is supported by an annual grant of money from the United States government.

The State station has separate grounds, leased for a nominal sum from the college, and has its own buildings. The Hatch Experiment Station makes use of the grounds of the college estate in so far as land for experimental purposes is required, and, although it has a few inexpensive buildings devoted exclusively to its work, it makes continual use of college buildings for some of its purposes.

The State Experiment Station has its own working library, though the members of its staff also make constant use of the college library. The Hatch Station has no separate library; that portion of its funds utilized for books contributing to the upbuilding of the general agricultural library of the college, which is available for experiment station workers, college professors and students alike.

The advantages to both of this close union of college and station are several. As to station, it would have been impossible for it to have accomplished much for several years, had it been necessary to procure and put into working order an independent plant. Further, the funds appropriated by the Hatch act must have proved utterly inadequate for the maintenance of an independent organization. Under the present arrangement, officers of the college do most of the work of the station, upon the grounds of the college and in the buildings of the college. The extra compensation for such work is small in comparison with what must have been paid for the entire time of men equally competent. The advantages to the station of this close connection with the college are thus sufficiently evident.

Let me now see what the college gains in return for what it gives. First and most important I consider the advantage to the students. The intimate relations between college and station make it possible to bring the students into closer touch and fuller sympathy with the experimental work which is being carried on. The professors, too, in their efforts to discover the problems which vex the farmers, and to help them to solve these problems, are kept in closer sympathy with the farming community. They gain a truer insight into its needs, and as a consequence are the better instructors. There is, however, undoubtedly a danger that these double duties may over-tax the time and lead to less thorough work than is desirable.

Having indicated the nature of the union between college and station, I must now consider the work of each branch of this agricultural institution in greater detail; and I crave your attention first to what I have to say concerning the college.

With the organization and general purposes of the Agricultural College you are all doubtless more or less familiar, and yet it appears to me desirable to touch briefly upon the more salient points. Organized at the outset under an act of Congress, the college has always received a large measure of financial support from the general government. The State also has given liberally for buildings (for which purpose the money from the general government cannot be used), as well as for other purposes, and at the present time the annual income comes in nearly equal amounts from the State and from the general government. Tuition is practically free to every son of Massachusetts, and we derive very little income from our students. Our present resources, although much larger than were those of a few years ago, are yet inadequate for our needs. For every single dollar we have to spend we can see the need of many. It is no part of my intention, however, to beg for the college. You want to hear what we have done, what we propose to do. Ours is an agricultural college, and it may be thought that the most satisfactory demonstration of the utility of such an institution would be afforded by the proof that we have educated many men to be good farmers. I shall show you that we have done this; but it is just because we do not make all, or almost all, of our students farmers, that we are often criticised. Let me attempt to show you why this is the case. Our institution is a college in which, to quote the language of the original act, under which it was established, "the leading object shall be, without excluding scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture . . . in such manner as the Legislature of the State may prescribe, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life." This language makes sufficiently evident the fact that it was something more than the mere training of young men to be farmers that the framers of the original Morrill act had in view. Had this been the object, a number of model farms in each State, upon which young men could be trained, would better have subserved the purpose. Or, at the most, farm schools instead of agricultural colleges should have been founded. That such model farms for the training of young men, and that farm schools where the practical side of farming should have been made especially prominent would have proved useful, I sincerely believe; and, as I shall more particularly point out later, I think there is a demand for one of these institutions now; but as sincerely do I believe that the Agricultural College has served even more important uses than such schools could have served.

It should be remembered that opportunities for practical training upon private farms existed on every side, while there were no places where the relations of science to agriculture could be studied. It was indeed scarcely recognized by the general public, at the time our Agricultural College was established, that the sciences had any particular relation to farming; and he who should have maintained that the farmer might profit from a liberal education, and that farming was one of the "learned professions," would have been accounted a visionary. It was scarcely suspected, even by the foremost men in the American agricultural world, that there was much pertaining to agriculture which could be theoretically taught. I have heard that one of our most prominent agriculturists remarked, when Professor Stockbridge, in planning the course of study, suggested a certain number of hours as desirable for class-room work in agriculture, "What are you going to do with so much time? I could tell all I know about farming in a very few lectures;" and it was implied, though not stated, that he knew about all there was worth knowing.

The college, then, has served agriculture most effectually in the higher field of creating an enlightened public sentiment, in awakening a spirit of investigation and inquiry, in creating a respect for the business of farming which had no previous existence; and, through the self-sacrificing efforts of its professors, in promoting desirable improvements in agricultural practice. A mere enumeration of the subjects of the investigations which have engaged the attention of the professors of the college would occupy a large share of the time I am allowed, and I shall not attempt it; I can but allude to a few which seem to me among the more important. Dr. Goessmann's work upon fertilizers has brought order out of chaos, as our fertilizer laws owe their origin in largest measure to his work and influence. His investigations in regard to the sugar-beet and sorghum as sugar plants are of permanent value, although economic considerations have rendered the profitable establishment of these industries here an impossibility under present conditions. Besides these leading lines of inquiry, he accomplished, while giving his entire time to the college, an enormous amount of useful work in determining the value of innumerable manurial and food substances, in pointing out the influence of special fertilizers upon the quality of fruits, and upon diseases affecting our crops.

Professor Stockbridge carried out those notable experiments which led to the introduction of special fertilizers for crops, — a field in which he has had countless imitators. He also conducted a large number of other experiments, which have led to numerous improved methods of farm practice. He was one of the earliest to demonstrate that the benefit derived from frequent cultivation of the soil in dry weather is to be explained by the fact that such treatment causes rather the more complete retention of moisture already present than the absorption of larger supplies from the air. He was thus able to point out how this "paramount fertilizer" might be the more completely brought under the control of the farmer. His experiments with the lysimeter and in demonstrating the origin of dew, his observations upon soil and air temperatures and his study of methods of feeding, are other important lines of work which he followed with valuable results.

The experimental work of President Clark attracted wide-spread attention; and, although not so evidently practical in its bearings as that of some other members of the faculty, it was of permanent value, and drew from so eminent an authority as Louis Agassiz the statement that, had all the money expended upon the college (this was in eighteen hundred and seventy-five) led to no other result than the production of that one paper, that alone would amply repay every dollar which had been expended upon it. Many are the students of those days who would testify to one beneficial result of President Clark's enthusiastic work which has not usually attracted much attention. I refer to the all-consuming passion for research and study of the secrets of nature which seized upon all, both colleagues and students, who were brought into contact at this time with this remarkable man. Who shall undertake to estimate the far-reaching effects of this one man's enthusiastic spirit?

Lack of time alone compels me to omit reference by name to the important work of other members of the college faculty in the early days before the experiment stations were organized. The work of Goessmann and Maynard in connection with the girdling of grape-vines, however, has proved of so great practical value that it must be thus briefly alluded to.

Thus far I have considered only what may be called the outside influence and work of the college, and have made no especial reference to the results of its work with its students. This branch of our subject must now be considered; but before taking it up I want to ask those of you who are old enough to remember to look back twenty-five years and compare the agriculture of those days with the agriculture of to-day. You will agree that many and important are the improvements which these years have brought, and I think you will admit that in bringing about these improvements the Agricultural College has played an important part.

But, after all, the chief work of the college is the education of young men who shall become the better farmers or serve agriculture the more effectively because of the education they receive. Since the college opened its doors to students, in the fall of 1867, it has received within its walls (not including students now in the college) eight hundred and seventy-nine men. We have at the present time one hundred and forty men. Of the eight hundred and seventy-nine who have studied in the college for longer or shorter periods, three hundred and sixty-one have completed the prescribed course of study and received the degree of Bachelor of Science.

Complete statistics of three hundred and thirteen of these men, the graduates of the last class not included, are at hand; and examination reveals the following facts: one hundred and sixty-two of these men, rather more than one-half of the entire number, are either farmers or engaged in closely allied pursuits. There are ninety-two farmers, and the remainder are distributed as follows: agricultural editors, four; fertilizer business, seven; teachers in agricultural institutions, twenty; experiment station directors, two; veterinary doctors, seven; professors of veterinary science, two; assistants in experiment stations, twenty-two; assistants in the Board of Agriculture, two; Gypsy Moth Commission, four.

I want particularly to call attention to the prominent position occupied by our graduates in agricultural colleges and experiment stations throughout the country. No other agricultural college has furnished so many men for such positions. One-sixth of all our graduates are employed in agricultural colleges and experiment stations. Among our graduates we find two college presidents, several professors of agriculture, two directors of experiment stations, and several vice-directors. Here indeed is a record to be proud of, for an institution that graduated its first class barely twenty-one years ago. Among those men not connected with agricultural pursuits we find nine lawyers, eighteen engineers and eleven teachers. Medicine claims no less than eighteen men, and there are two dentists and four clergymen. These men, occupying the prominent positions they do, educated in sympathy with agriculture and understanding its needs as they should, must exercise a powerful influence in its favor. Many of them will doubtless some day own and manage farms.

Business claims the greatest number among those of our graduates who are not farmers, and no one who remembers the splendid opportunities for the acquirement of wealth in business pursuits will wonder that this should be the case.

Our graduates touch agriculture, however, at other points. Indeed, wherever they are found they are usually prominent in every movement which tends to uplift the agricultural classes. Thus we find among them numerous presidents and secretaries of our agricultural societies, and members of the State Board of Agriculture. Two among them have been masters of the State grange, two have been lecturers of the State grange, and they are everywhere at the head of local granges, farmers' clubs, etc.

Surely no one who investigates the record of our graduates will be disposed to deny that it is a creditable one.

If it be objected that our graduates are not all farmers, let me ask whether the proportion among our alumni engaged in farming is not greater than is the proportion among farmers' boys who never get beyond the high school who till the soil. You must remember that a large proportion of the young men who come to us come with no intention of making farming their life-work. The opportunities in other walks of life are so great, it is not to be wondered at that many are attracted thereby. That our graduates would not all become farmers was indeed foreseen at the outset. Upon this point I cannot do better than to quote the words of President Chadbourne, who, writing at the time of his first incumbency, in eighteen hundred and sixty-seven, said: —

"The fear is expressed by some that, if an attempt is made to give a truly liberal education, the students will turn aside from agriculture to other pursuits. Undoubtedly some of them will. If such an education is given in practical science as ought to be given in such an institution, there will be a demand for its students as teachers and in other professions. And it would be an education entirely unworthy of Massachusetts, and contrary to the plain intent of the act of Congress donating the land, if it were so meagre in its requirements that the students should be fitted only for one pursuit in life. No surer way could be devised to defeat the very end for which the college was established, than to conduct it on a plan which proclaimed, in theory and practice, that its students were to be kept in ignorance of certain things, lest they should be above their calling. No institution can ever succeed on such a plan, and it ought not. It is difficult to see what a student would enter such an institution for. Such views are repugnant to every generous feeling which an educated man ought to possess, contrary to the principles of our institutions, and are not sustained by the present position of the agriculturists of this State. The adoption of such a system would be simply saying to the farmers of Massachusetts that they are tillers of the soil, because they are too ignorant for other pursuits. An entirely different principle has been acted upon in organizing the college."

It appears, from the figures which I have given, that we have graduated rather less than one-half of the men who have entered the college; and it may be thought singular that the proportion completing the course is so small. The experience of other colleges, however, has been very similar, the proportion of men graduated, in the case of our oldest and largest colleges, being even less than with us. The reasons why so large a proportion of our students fail to graduate are various. Many come to us with the idea of taking only a part of the course; many more are obliged to drop out on account of inferior scholarship; others leave us for financial reasons, or because of the death or illness of relatives; and some, it must be admitted, leave us because of dissatisfaction with the course of study. Why this dissatisfaction exists, and the methods we are now considering with a view to removing it, will be considered later. I want, right here, however, to add, concerning these non-graduates, that very many among them are a great credit to the college. Among them are numerous of our most successful farmers and gardeners, and men prominent in various walks of life.

It is significant that the proportion of non-graduates who become farmers is less than that of the graduates who select that calling. In 1886, the latest date up to which complete statistics of non-graduates are available, twenty-eight per cent of these men were farmers; while at the same time thirty-one per cent of our graduates were farmers.

It is significant, also, that the proportion of men entering college who complete the course now is considerably larger than in the earlier days. Of the six hundred and forty-three men who had entered and left the institution up to 1886, thirty-seven per cent had graduated; while since that date two hundred and thirty-six men have entered, and one hundred and twenty-four, or fifty-two per cent of that number, have been graduated. This change is doubtless due to various causes, among which one of the most important is the gradual gain of the college in popular favor and respect, due to a fuller knowledge and appreciation of its objects, and the results of its work, as well as to the influence of its alumni, than which no more loyal body of college men can anywhere be found. The more complete endowment of the college by the United States government, its more liberal support by the State, and the consequent establishment of additional professorships and the fuller equipment of every department, are other causes which have contributed in a marked degree to the distinct gain in efficiency as an educational force which has characterized recent years, enabling the college to offer greater advantages to its students, and thus to retain a larger proportion of them. The labor fund also, providing as it does opportunities for self-help, has undoubtedly exerted an important influence in the same direction, though it is yet too early for this influence to have made itself fully felt.

No educational institution in the world I believe has better natural advantages. Our location is a magnificent one. It lies in the midst of the most prosperous agricultural region in the State. The farm, splendidly suited to the purposes to which it must be put, contains a variety of soils so wonderful that some one in speaking of it has said that on the college estate one may jump from a gravel bank into a peat bog. The sites of our buildings, perfect from a sanitary stand-point, command a view of some of the most charming natural scenery in New England. Every one who visits us exclaims, "What a beautiful spot;" and those who visit us more than once, "The place appears to me more beautiful every time I see it." That nothing could be better naturally suited for the purpose to which it is put, is the opinion of all.

In this beautiful spot, for which nature had seemingly done everything, gifted men have spent a lifetime in earnest, patient, self-sacrificing endeavor to build up a great agricultural college. Through dark days as through bright they have toiled on; and the dark days, the days when the enemies of the college were numerous and its friends apparently few, have been many. With no patterns to follow, no precedents to guide, they have worked on; and, in spite of obstacles innumerable, have built up an institution of which the State should be and is proud. We have to show to-day in Amherst a farm rapidly approaching a state of thorough and systematic culture and high productiveness; we have most of the prominent breeds of cattle, and excellent specimens of a few breeds of horses, sheep and swine (we should have more); we are rapidly acquiring a full line of illustrative specimens of all the various styles of farm implements and machines; and we are building up a great museum, to contain everything connected with agriculture, — rocks, soils, fertilizers and fertilizer materials, seeds, crops, plants, animals and insects, — all will find their place. We have a splendidly equipped horticultural department, with plant-houses, nurseries, gardens, orchards and vineyards, wherein may be seen all prominent varieties of garden, orchard and vineyard crops, as well as a very full collection of ornamental species. We have model dormitories, a fine chapel and library building, and a convenient drill-hall. We have laboratories and apparatus; our library is already one of the most complete agricultural libraries in the country, and is rapidly growing, thanks to the enthusiastic labors of our president.

In this beautiful spot, and working with this measurably adequate equipment, we have an earnest body of ten men, the faculty of the college. And yet, as I have admitted, there has undoubtedly been some dissatisfaction on the part of some of our students. This is perhaps up to a certain extent inevitable; but it may have been, and I think it has been, in part due to a removable cause. I may not be right; but, first as student and later as teacher, I have had considerable opportunities for observation, and I believe that one great cause for such dissatisfaction as has existed has been due to the nature of the course of study. It has been an attempt to suit in the same course two widely different classes of men. I should be unjust to characterize these two classes as the bright and the dull. Those whom some might call dull, in their own way may be as bright as the others. But in every class which has entered may have been found, to borrow a somewhat famous expression, a line of cleavage. On the one side of this line are found the men with the greater aptitude for books, the men who have received superior preparation for entrance, the men who have no taste for manual labor with their own hands, the men who propose to get a living by intellectual rather than by physical exertion, — men who, if they elect to serve agriculture at all, will serve her as teachers, writers, investigators, engineers, veterinarians. On the other side will be found men, usually from country districts, who have less aptitude for books and science; men who have received an inferior preparation for admission; men, often from farms, who propose to go back again to the farm, to guide the plough with their own hands; men who will serve agriculture perhaps even more efficiently than those of the first class, but by exhibiting in their own persons the possibilities of enlightened farming; men who will practise while (perhaps not what) the others preach. I would condemn neither the preacher nor the practical man; I make no pretence of placing one above the other. There is room and there is work for both. We should endeavor to serve both; but the effort to suit both in one course of study and training is foredoomed to failure. Far is it from my intention to underestimate the value to him who guides the plough of a liberal education. None perceive more clearly than I that it will vastly increase such a man's chances for success and his capacities for enjoyment; but I would look the facts squarely in the face, and the fact is that many who come to us feel that they cannot spare either the time or the money for an extended course of study, and they in many cases lack the aptitude or the taste for it. They would like to become better farmers than their fathers have been, and they come to us only to become dissatisfied when they find that languages, "ologies" and numerous abstruse sciences must be acquired before they can graduate. A partial course will not help them as much as they should be helped in the time they have to give for study. The studies and training offered these men should be more practical, and the course should occupy a shorter time than four years. We cannot modify any one course of study to make it suit both these men, and those who look towards intellectual work. The two classes of men are on an unequal footing intellectually when they come to us. The same kind of food cannot be made to suit both.

In view of this state of affairs, we are in favor of offering two distinct courses of study; and the faculty of the college are now considering a plan which includes this as one of its essential features. One course will be for four years, the other for two. For the first the requirements for admission will be put somewhat higher than at present, and the studies of the last year will be elective. The general outline of the first three years of this course will be much as at present; agriculture and horticulture will be required of all. In the last year agriculture, horticulture, chemisty, mathematics, entomology, veterinary, German and social science are made electives, among which each student must select three. The restricted number of studies pursued by each student during this last year makes it possible for him to devote more time to the subjects of his choice. It is hoped that the course thus modified will prove more satisfactory to those more intellectually inclined, and result in turning out men better qualified for work in the particular lines selected by each.

For admission to the two years' course the requirements will be put somewhat lower than at present. The especial object of this course will be to train young men to be better practical farmers; but at the same time, in so far as may be found practicable, it will be made to prepare for the longer course. So much of the sciences will be taught as has a directly practical value to the working farmer, enough to enable him the better to understand and apply the results of experimental inquiry. It is confidently anticipated that the shorter time required, the diminished expense and the more directly practical bearing of this course, will attract a class of young men whom we may benefit enormously by means of the training proposed; but who either never would (in some cases never could) have undertaken the longer course, or, having undertaken it, would have found it poorly suited to their requirements, and dropped out, dissatisfied, and prepared but little better for their life-work than when they entered.

In connection with these changes we are also considering plans for offering advanced work in the various departments, to which all who have received the degree of bachelor of science will be eligible. Upon the satisfactory completion of these courses degrees will be given.

These proposed changes are somewhat in line with those which have been made in other institutions of learning in recent years; and it is hoped and confidently expected that upon their adoption our Agricultural College will be found better adapted to accomplish for all classes all the good which its founders had in view than it has thus far proved. These changes, however, mean increased work, and will necessitate the employment of additional teaching force, and the provision of increased accommodations.

Concerning the Hatch Experiment Station I must be much more brief, and, since its work covers a much shorter period and most of you have undoubtedly received its publications, this will be possible without leaving you uninformed upon essential points.

This experiment station was organized in 1888. The general outline of its organization has been given, and a statement that it derives its support from the United States government has been made. It does not maintain a separate establishment for chemical work. An arrangement with the State experiment station, whereby the latter receives a share of our income in consideration of performing our chemical work, has been in force from the first. Aside from this and the joint employment of a vegetable pathologist, the work of the two stations is independently carried on. It is the intention to make the work of each cover different ground.

The president of the Agricultural College is the director of the Hatch Station; the professor of zoölogy is its entomologist; the professor of horticulture, its horticulturist; the professor of mathematics, its meteorologist; and the professor of agriculture, its agriculturist. Assistants are employed in each of these departments. These are generally recent graduates of the college in the departments of agriculture and horticulture; undergraduates for certain work in the entomological and meteorological departments; and in addition young women in the entomological department. Students of the college are also largely employed, especially in the horticultural and agricultural departments, in the performance of such work as may safely be entrusted to them, and very satisfactory workmen they usually are.

The work of the station covers a wide ground, and its results are published in the form of bulletins, of which up to the present time we have issued twenty-two, besides the monthly bulletins of the meteorological department. The attempt is made to make our investigations cover topics in which the farmers and gardeners of the State appear to be interested, as shown by the letters of inquiry which are sent us; and, in addition to reports of experiments carried out here, we have issued several bulletins giving information upon matters of general interest to farmers.

Those upon the gypsy moth, tuberculosis, and the profitable use of commercial fertilizers have been of the latter class. In meeting the expense of publication and distribution of some of these we have received assistance from the State Board of Agriculture; and the Massachusetts Society for the Promotion of Agriculture now unites with us in assisting to circulate thirty thousand copies of a forthcoming bulletin upon four of our commonest and most destructive insects, viz., the tent caterpillar, the fall web worm, the tussock moth and the canker worm.

Two things show conclusively the increasing interest in our work, viz., the growing demand for our bulletins and the increased correspondence of all departments. The earlier editions of our bulletins numbered sixty-five hundred; our later editions number eleven thousand.

The number of letters received asking for information upon points connected with farming has rapidly increased. Especially marked is this increase in the entomological department, the correspondence of which has reached such dimensions as to necessitate the employment of a stenographer. In all departments the correspondence is a considerable tax upon the time and energies of those in charge. It is not simply the time required in writing the letters; many of the questions sent are of a character which necessitate considerable research. We, however, recognize that the assistance we may be able to render the farmers in this way may be considerable, and we gladly welcome, even invite and solicit, such correspondence.

Time fails me to speak explicitly of all the experiments which have been carried out in the Hatch Station. I shall endeavor only to give a general idea of the equipment of each department for its work, and to call attention to some of the more important results.

The meteorological department is one of the best-equipped stations in this country. It contains a complete set of Draper's self-recording instruments and Thomson's electrograph. By means of these instruments a very complete record of all variations in climatic conditions is secured, and the chief results are published monthly. Professor Warner, who is in charge of this department, has been making a special study of the relations of electricity to agriculture; and in Bulletin No. 16 of our station he has given a brief account of the results of the work of others in this direction, as well as of a few experiments of his own in this field. He finds, both in the results obtained by others and in those of his own work, encouragement to believe that in electricity the farmer and gardener may yet find a willing assistant, powerful in its influence for good, both in promoting vigorous growth, and in protecting from the various blights and mildews which attack our crops.

The entomological department is provided with a small building known as the insectary, and connected with it is a small plant-house. This establishment is a busy place, especially during the season when insects are active. Here at that season you will find innumerable insects, in cages and gauze-covered boxes, whose life-history is being studied. Several assistants are kept busily employed in feeding and tending them, and in taking and filing away careful notes upon their peculiarities. No innocent caterpillar can even make a change of clothing but it is recorded in the book of fate, to be opened, — not perhaps on the day of judgment, — but when a bulletin is to be published which shall so carefully set forth his every peculiarity that every farmer who reads shall know his weakness, and, knowing, strike at the opportune moment which comes some time in the life of every insect. Only when we know our enemies can we cope with them to the best advantage; and the object of all this faithful observation and note-taking is to make us acquainted with insects.

Not all are enemies however, far from it; some are among our best friends, and to distinguish friends from foes is important. This the work of the station will enable us to do; and as further important means to that end may be mentioned the preparation of a complete collection of inflated caterpillars, which is being pushed as rapidly as possible.

Among very destructive insects which have received a large share of attention may be mentioned the gypsy moth and the cranberry insects. The work in the attempt to exterminate the former is generally known. It may not be as generally understood that Professor Fernald, who is in charge of the entomological department of our station, exercises a general supervision over that work. His work with the cranberry insects was begun in 1890; but so little is known concerning some of them that considerable time must probably elapse before results of great practical utility are obtained.

The study of insecticides has also engaged a share of Professor Fernald's attention. Much has been learned within a few years in regard to their use; but the questions what to use, in what strength to use, and when and how to apply, cannot yet in many cases be answered, and he is seeking for the answers.

The preparation of a card catalogue of North American insects is now engaging a large share of the working force of the entomological department. When completed, by reference to it one can see at a glance just where to find everything which has ever been written upon any North American insect; and can thus learn what is already known concerning it, — a point of the greatest importance for one engaged in the study of insects.

In the horticultural department a large share of attention is devoted to the testing of new varieties of fruits. Professor Maynard, who is in charge, regards this work as very important, believing that the farmers and gardeners cannot well afford the cost of making such trials. To show something of the extent of this work, allow me to present a few figures. There are on trial now on the grounds of the station one hundred and twenty-five varieties of strawberries, one hundred and twenty-five of grapes, twenty-five of blackberries and twenty of raspberries; while all the new varieties of pears, peaches, plums, and cherries are put on trial as they come out. Few of these new varieties are found valuable; but this fact does not lessen the necessity for such work, for all are highly extolled by their introducers, and their claims must be put to the test of impartial trial.

Of the different investigations undertaken in this department, perhaps none has attracted more wide-spread attention than the comparative trial of steam *versus* hot-water heating. I have no time for details; suffice it to say that the results were decisive in favor of the economy of hot water.

Following this, an experiment has been commenced to test the comparative merits of overhead and underbench piping. These two systems were under comparative trial during last winter, but the results were not decisive, and the experiment is to be continued.

The discovery of a method of protecting young fruit trees from mice by painting in late fall with a mixture of cement and Paris green (one tablespoonful of the latter to four quarts of a rather thick paste of cement and water) is a valuable result of Professor Maynard's work.

The careful testing of various solutions and preparations recommended for spraying fruit trees and vines, as well as some of our garden crops, for the prevention of disease and the destruction of insects, and the trial of apparatus devised for such work, occupies a large share of attention. This work is extensively carried on upon our own grounds, and to some extent upon the grounds of prominent fruit growers in different parts of the State, under the general charge of the officers of the station. As one prominent result of such work, Professor Maynard concludes that grape-vine mildew can be entirely prevented, apple scab may be largely prevented, the coddling moth may be held in check, and black-knot he hopes to be able to prevent. Potato rot also can apparently be largely prevented by spraying the vines with the Bordeaux mixture.

The work in the agricultural department began one year later than that in others, on account of the vacancy in the chair of agriculture during the greater part of the first year of the station's existence; and it has been further impeded by the destruction by fire of the barn devoted to its work in the spring of 1891. This has now been rebuilt, but is not yet completely fitted up for the work which is in contemplation. A large share of the funds available in this department, as well as of the energies of its officers, has been expended in carrying out soil tests with fertilizers in different counties in the State. These experiments were commenced in 1889, and have been continued every year. Altogether, we have carried out thirty-eight such experiments, each occupying an acre of ground. Eight of these have been carried out upon our own grounds and thirty upon farms in the different counties of the State. Twenty-four of these experiments have been with corn, with which crop we began our work; six have been with potatoes; six with oats, with which mixed grass and clover seeds have been sown; and two with mixed grass and clover.

Besides these, we have prepared fertilizers for, and exercised more or less oversight over, a large number of experiments of the same character, most of which have been with corn. The leading object in all these experiments has been to determine the fertilizer requirements of the different soils for these crops.

Omitting all details, I may say that the results of our work with corn have been quite decisive. They indicate that for this crop potash should be far more generally and liberally employed. Special corn fertilizers do not as a rule contain this element in sufficient amount. To get enough potash when using these we must apply more phosphoric acid and nitrogen than the crop needs. It will pay to combine potash with them. Our experiments also indicate that with ordinary farm or stable manure it will pay to use some potash, and for the corn crop the muriate is the cheapest form.

For potatoes the results are of the same general character, but less decisive. In these experiments the muriate was the source of the potash used. The results of special experiments tried this year for the purpose of comparing the sulphate and the muriate of potash for this crop have shown decided differences both in yield and quality in favor of the sulphate; and I believe, had this salt been used in place of the muriate in our soil-test work with potatoes, the results would have been more decisively in favor of the potash. Special potato fertilizers are as a rule too poor in this element.

With oats our results have been different, and when it is remembered that the experiments with this crop have been tried upon the very fields where corn and potatoes gave the largest increase with potash, this fact is the more striking. This crop responds most freely to an application of nitrogen in the form of nitrate of soda.

Mixed grass and clover, following the next year after oats, having been sown with them, have taught a striking object lesson. The grass, like the oats, gives most decisive increase after application of nitrate of soda; but the clover follows the potash. Wherever that has been applied, the proportion of clover is much larger than elsewhere, and its vigor of growth strikingly greater. The liberal use of potash I think solves the problem of growing clover; and when it is remembered that this plant is one of our most efficient nitrogen gatherers, drawing this — the most costly constituent of fertilizers, largely from the air, the importance of acting upon this knowledge becomes sufficiently evident.

The testing of varieties of crops new to this section has occupied considerable time. The chief varieties under trial have been three millets, — two of them new species to this locality; several varieties of Japanese beans; Japanese radishes, of two varieties; as well as several varieties of hemp and flax, wheat, oats and corn.

The millets promise to be valuable fodder crops; two of the species this year have given yields of about twelve tons of green fodder to the acre. A part of these has been fed green, with very satisfactory results, and several tons of each have been put into the silo.

Of the beans, several varieties of the species commonly known as the soja bean prove well adapted to our climate. They ripen their seed with as great certainty as corn, and may prove of use as grain crops. These beans are the richest known vegetable food, and are readily ground into meal.

We have tried a number of different experiments in feeding milch cows, with a view to comparing different food stuffs. In one experiment we fed forty pounds of mangolds, in comparison with thirty pounds of corn silage, finding the latter to considerably excel the former, giving larger yields of both milk and cream, and causing a gain in flesh.

Another experiment was for the purpose of comparing millet meal with corn meal, — equal quantities of each. The millet meal gave slightly more milk, but the two seem nearly equal in value.

Still another was for the comparison of millet straw and corn stover. The results were slightly in favor of the straw, but there was no great difference.

A fourth experiment was for the comparison of soja bean meal and cotton-seed meal. But a small quantity of the bean meal was available for this experiment, and it was tried with only two animals, and during but twelve weeks. One of these animals gave a result decisively in favor of one food, and the other for the opposite food. I am justified simply in judging that the two must be of about equal value. Should this conclusion prove well founded, we have in early varieties of the soja bean a crop by means of which the farmer may escape the necessity under which he now lies of buying largely of bran and cotton seed or similar feeds.

A large number of experiments for the comparison of various kinds and combinations of fertilizers with different kinds and amounts of manures for the production of grass in permanent mowings have been carried out. The manure has generally given the largest increase in crop; but, cost considered, it would pay better to buy fertilizers than to buy manure for this crop. A combination of two hundred pounds of muriate of potash with four hundred pounds of dry ground fish has given satisfactory results; but in the light of later experiments I would add some nitrate of soda to this mixture.

I have given but a very imperfect and hurried outline of the work of college and station, and called attention to but few of its results. If I have said enough to arouse your curiosity, so that you will send for and read our publications, or, better, come and visit us that you may judge for yourselves what we are doing, I shall be more than satisfied.

In conclusion, let me urge that you put yourselves in sympathetic touch with us. I invite your questions now, we at the station invite your questions always. It is our place to serve you. Let us know what you need, and, so far as our means and energies permit, we will endeavor to satisfy your demands.

The CHAIRMAN. Gentlemen, there is now an opportunity for you to ask the professor as many questions as you see fit.

Mr. AUGUSTUS PRATT. Mr. Chairman, before the questions are asked, I would like to say a few words. Some twenty-three years ago, when this college was in its infancy, I was a member of the committee on agriculture in the Legislature of Massachusetts. The college then had only been in a working condition some two or three years. The committee on agriculture were invited up there to see the grounds and the college, through President Clark, and I wish to endorse every word that has been said here of his enthusiasm in starting this college. We were invited up there as a committee of the Legislature, to look over the ground and present the case to the Massachusetts Legislature. The college had asked for an appropriation of $50,000, and at that visit I was much pleased with what I saw; and when we came back to Boston, accompanied by President Clark and Col. Walter Stone of Dedham, I won't tell you how much opposition there was. The members said that these young men who were brought up there would never make farmers, and it was useless to undertake any such scheme; and it was ridiculed by members of the Massachusetts Legislature, — the idea of an appropriation of $50,000 for this institution. But through the energy and influence of such men as have been alluded to here, President Clark, Professor Stockbridge, Col. Marshal P. Wilder, Colonel Stone of Dedham, and others, this $50,000 appropriation was granted; and, as I visited those grounds last year and year before last, I could hardly realize that I was in the same place. It seemed to me that there had been a work of progress going on there that fully justified every dollar that has ever been expended there, and that it was a work that was going to be for the great good of the farming community of this State. I believe to-day that it is one of the best institutions that the State of Massachusetts has, and I hope it may be encouraged by every farmer, in every way, and that it may progress for the next twenty-three years as rapidly as it has for the last twenty-three.

Secretary SESSIONS. I want to make a suggestion, in view of the fact that we have two other papers this forenoon, that suggestions should be given rather for the guidance of the faculty of the college than for your information upon specific subjects. If you have questions for information upon specific subjects, I think it will be better for you to transmit them to the professor in writing, to him at the college, and you will get your answers. We have not time to go into the matter of experiments.

Mr A. C. VARNUM (of Lowell). Mr. Chairman, will the professor explain a little more fully the object and the advantages of the labor fund? I find a good many of the farmers do not quite understand it.

Professor BROOKS. This is an appropriation of $5,000 per year, made by the State for the purpose of giving assistance to students who are desirous of working their own way through the college. It is not charity, but money that the State appropriates for the employment of these young men; and a very large share of the students now there avail themselves of the privilege of the labor fund. They can be given employment, the object of which is largely the improvement of the estate. As one consequence of the labor fund, two years ago we built in one single year about five miles of tile drains.

Mr. VARNUM. All done by the students?

Professor BROOKS. Very largely done by the students. This labor fund has two important advantages: it enables the young men to earn their own way, and those are the ones we want to help; and it enables us to carry out the work of improving the estate much more rapidly than we could otherwise do. The labor fund is not sufficient; we are obliged to refuse young men work simply because the money is all expended. The money was entirely expended early in November of this year. It ought to be double that. Sometimes a young man comes to me and says, "I have got to leave the college. I am dependent on what I earn. I must earn enough to pay my own board. If I can't do that, I must leave." I have suggested to the faculty that they be allowed to work, and it be credited to them on the books and carried over; but you will see where that will land us another year.

Mr. MCINTOSH. I think we ought to send a representative to the Legislature to put this matter before them. I believe in employing every student there that wants to work. It is the man that does not want to work that most of the trouble comes from all over the country now. I like to encourage men to be well educated, to be practical, which is most important of all.

Mr. Appleton. Mr. Chairman, I should like to say a word for the labor fund in another way. In the classical colleges they have funds, and the men who show their mental ability are given an interest in those funds. At our college that $5,000 a year represents the income from the State, and that is given to men at the college in proportion as they show their ability and readiness to do physical work simply. It is a bonus for men who are doing physical work.

President Goodell. I should like to say just one more word. Allusion has been made by Mr. Appleton to the scholarships that are given in the classical colleges. In the classical colleges it is, in other words, a premium to men to go there to college, and they do not work for it in return. It is a premium on laziness. It is not so in the agricultural college. For every cent of money that is paid out to those boys we get an honest equivalent in labor that comes back in return, to the State. It is not charity. It is simply assisting young men to get an education that they could not get in any other way whatever.

Mr. Appleton. I do not understand the president takes exception to what I say?

President Goodell. Not at all. I only want to make the distinction between the two.

Mr. E. Moore (of Worcester). Do they intend to incorporate instruction with their mental labor and their physical labor? Is it to help them in any degree?

Professor Brooks. Much of the work which is carried on is instructive; for instance, that to which I alluded, — the work in tile draining. Most of the men there had never seen anything of such work, and by actually engaging in it and seeing all the various operations connected with it, they learned a great deal. But these young men must work whenever they have an opportunity, every day and all the time. It is not possible to make all the work they engage in instructive. They must take hold of anything that needs to be done at the time when they have leisure to do it.

Mr. Moore. Do they study engineering there?

Professor Brooks. To some extent.

Mr. Moore. Did they employ students to carry on the engineering in the tile draining?

Professor Brooks. Yes, the work has been done entirely by the students; and I have students now employed under the labor fund in making a careful survey of the whole estate and mapping it.

President Goodell. How many miles of tile drain were made by students?

Professor Brooks. We have something like ten miles, done within the last three or four years.

The Chairman. Gentlemen, we must pass on to the next subject, as the time is going fast, — the "Work of the State Agricultural Experiment Station." We have a gentleman with us who is very familiar with that subject, and I take pleasure in introducing to you Dr. C. A. Goessmann, director of the Massachusetts State Agricultural Experiment Station.

ON THE WORK CARRIED ON AT THE MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION DURING 1892.

BY DR. C. A. GOESSMANN, DIRECTOR.

Mr. Chairman, Members of the State Board of Agriculture, Ladies and Gentlemen: — I am instructed by Secretary Wm. R. Sessions to speak to you of the work carried on at the Massachusetts State Agricultural Experiment Station during the present year, 1892, and it gives me pleasure to comply with his request.

The State Agricultural Experiment Station was established by an act of the State Legislature in 1882; the Board of Control, to whom the supervision of the station was assigned, met during the autumn of the same year, and made provisions to begin actual work upon the grounds of the station April 1, 1883.

The work since carried on at the station, with the consent of the Board of Control, is published in accordance with our State laws regarding this matter in the form of periodical bulletins and annual reports. Forty-five bulletins and nine annual reports have thus far been published for general distribution, free of charge to all parties interested. The number of copies of annual reports published of late amounts to twenty-five thousand, of which fifteen thousand are sent out in connection with the annual reports of the secretary of the State Board of Agriculture, and ten thousand by the director of the station, on application. The number of bulletins annually issued varies from four to five. Each bulletin has an edition of ten to eleven thousand copies. Aside from these publications are also issued monthly circulars, containing the official analyses of commercial fertilizers. Four or five circulars of seven thousand copies each are issued during the year.

Some of our observations during the present year have already been published in short abstracts in the form of bulletins and circulars. A more detailed description of these, in common with those in other lines of investigation, will be ready by the first of January, making our tenth annual report.

A mere outline of the work accomplished during the present year must suffice on this occasion, on account of limited time. Taking the character of our work at the station into consideration, it seemed advisable to arrange the present discussion in three special chapters, namely:—

I. Experiments with stock feeding.

II. Field experiments with raising farm and garden crops.

III. Special work in the chemical laboratory.

As some investigations are continuations of experiments inaugurated in preceding years, it will be necessary, in the interest of a mutual understanding, to call your attention in some instances to some results and facts already stated in preceding reports.

I. Feeding Experiments.

(Milch cows, steers, lambs, pigs.)

A. *Feeding Experiments with Milch Cows* (Two.)

Cows. — Five or six cows, grades, of different periods of lactation, served in each trial. They varied in age from five to nine years; they were secured soon after calving, and took part in trials until they yielded only from five to six quarts of milk per day.

First Feeding Experiment (*November, 1891, to March, 1892*).

Average daily fodder rations per head: —

Fine Feed Stuffs. — Corn meal, wheat bran, Chicago maize feed; or Chicago maize feed, wheat bran, cottonseed meal.

Coarse Feed Stuffs. — English hay and sugar beets, 15 pounds each; or corn stover, from dent corn (Pride of the North), and sweet corn (Stowell's Evergreen), 12 to 15 pounds each; or corn ensilage, of either variety as above, 32 to 40 pounds each, with English hay, 5 pounds.

The market cost of the daily grain feed rations varied from 10.5 to 11.5 cents. The market cost of the daily coarse feed ration varied from 4.00 to 14.0 cents per head. The daily yield of milk, it has been noticed, is in a higher degree affected by the *coarse feed* part of the daily diet, than by the *grain feed* part.

The quality of the milk depends to a considerable extent on the character and quantity of *grain feed* used; the *condition* and the *constitution* of the animal controls the degree of improvement in the quality of the milk.

Second Feeding Experiment (May 27 to Sept. 27, 1892).

Average daily fodder rations, per head: —

Fine Feed Stuffs. — Buffalo gluten feed, wheat bran, cotton-seed meal, 3 pounds of each. (No change during experiments.)

Coarse Feed Stuffs. — (May 27 to June 13.) 1. Green rye, 14–15 pounds; rowen, 5 pounds. (June 18 to June 28.) 2. Peas and oats, 27–28 pounds; rowen, 5 pounds. (July 4 to August 3.) 3. Vetch and oats, 37–38 pounds; rowen, 5 pounds. (September 17 to September 27.) 4. Serradella, 20 pounds; corn fodder, 30 pounds; rowen, 5 pounds.

The local market cost of the daily grain feed ration was 11.1 cents; the local market cost of the daily coarse feed ration varied from 9.80 to 5.33 cents. The market cost of the whole daily diet varied per head from 20.9 to 16.43 cents. The obtainable manurial value of the daily rations varied from 9.9 cents (1) to 13.40 cents (4.)

B. Feeding Experiments with Young Steers for the Meat Market.

Three feeding experiments with young steers have thus far been conducted at the station, a fourth one is at present under way.

Our results thus far obtained are on the whole rather more instructive than remunerative. A market price of 3½ cents per pound of live weight in case of yearlings, with $3\frac{3}{4}$ cents per pound of live weight in case of matured steers, it will be conceded, leaves but a small chance of cash profit. The largest daily increase in live weight in case of any diet thus far experimented with was 0.46 pounds per 100 pounds of live weight, in case of two yearlings weighing from 650 to 700 pounds each at the time. In case of two-year-old steers, weighing at the time from 1,150 to 1,200 pounds, it amounted to 0.30 pounds per 100 pounds of live weight. The one-year-old steers had gained daily in weight 2.90 pounds per head, and the two-year-old steers 3.40 pounds per head. These results were obtained in both instances in connection with the same diet per head.

Grain Feed. — Wheat bran, Chicago gluten meal, 3.8 pounds each; or wheat bran, old process linseed meal, 4.0 pounds each.

Coarse Feed. — Corn ensilage, 40 pounds to yearlings, 75 pounds to two-year-old steers.

The market price of these daily fodder rations per head was 14–15 cents in case of yearling steers, while in case of the two-year-old steers it amounted to from 18.5 to 19.5 cents per head.

To cover the local market cost of the daily fodder ration consumed, in view of our local market cost of dressed beef, $5\frac{3}{4}$ to 6 cents, which quite closely corresponds to $3\frac{3}{4}$ cents per pound of live weight of matured steers, would require a daily increase in live weight of 3.9 pounds in case of yearlings and of 5 pounds in case of two-year-old steers. Our results fell behind in gain per day 1 pound in case of one-year-old steers, and $1\frac{1}{2}$ pounds in case of two-year-old steers, to cover the outlay for feed. As the obtainable manurial matter of the feed consumed had a commercial value equal to one-half of the market cost of the feed consumed, we secured valuable articles of plant food at one-half of their market cost, besides disposing of our home-raised fodder crops at liberal retail prices.

The growth of our upland meadows is evidently too costly a fodder article to serve to any extent for an economical production of beef. The majority of pastures furnish too scanty a supply of fodder, without a supply of feed from outside sources, to meet the requirements of a paying increase in live weight.

A more general use of fodder corn, corn stover, corn ensilage, supported by a more liberal introduction of rich annual leguminous fodder crops, offers more promising results.

C. *Feeding Experiments with Lambs.*

Winter feeding experiments with lambs for the meat market have been carried on for years. From six to nine lambs are usually secured for that purpose towards the close of October.

We pay usually from 5 to 5½ cents per pound of live weight, and sell at 11 to 11½ cents for dressed weight, and from 21 to 23 cents per pound of wool.

During our last experiment equal weight parts of wheat bran, and Chicago maize feed, from 5 to 6 ounces per head, served as grain feed, with either 1.4 pounds of rowen or ½ pound of rowen and 2¼ pounds of corn ensilage, or ½ pound rowen and 2½ pounds roots (globe mangolds), as the coarse feed of the daily diet.

The average cost of the daily diet has varied from 1.6 to 1.9 cents per head; the highest daily gain in live weight has been 0.36 pounds per head.

Experiments are under way to ascertain the rate of digestibility of some new feed stuffs with sheep.

D. *Feeding Experiments with Young Pigs for the Production of Pork, 1892.*

The results of fifteen different feeding experiments with young pigs, grades and thoroughbreds, have already been published in our preceding annual reports.

Three new experiments are ready for publication. We keep usually during the whole year for every cow in our dairy one young pig to dispose of the skim-milk.

The animals are bought when from four to five weeks old, and weighing 18 to 25 pounds each. They are killed when from 180 to 190 pounds in weight. From 112 to 120 days are usually required to produce the stated live weight.

Our daily supply of skim-milk rarely exceeds 5 quarts per pig. We begin feeding usually with from 2 to 3 ounces of corn meal for every quart of milk fed at the time. This is kept up until a live weight of 65 to 70 pounds per head has been reached, when we increase the corn meal gradually to 4 ounces per quart of milk.

The additional feed required subsequently is made up of either a suitable mixture of several articles of commercial feed stuffs, as ground barley, wheat bran, dried brewers' grain, gluten meal, oil cakes or Chicago maize feed, or some single feed stuff, as Buffalo gluten feed or Chicago maize feed.

During the present year we tried the following system: —

1. Skim-milk, boiled potatoes (small), with ground barley, wheat bran and Chicago maize feed.

2. Skim-milk with corn meal and Buffalo gluten feed.

Our last two experiments gave very satisfactory results.

The feed consumed per pound of dressed pork has cost us 4.6 cents. The value of the obtainable manure is two-fifths of the cost of the feed consumed. Dressed pork has sold of late at from 6½ to 7¼ cents per pound.

II. On Field Experiments (1892).

The lands assigned for the use of the State Experiment Station cover an area of fifty acres. Ten acres are natural wood lands, and forty acres, including the space occupied by the buildings of the institution, are used for the production of farm crops. From fifteen to sixteen acres are ploughed lands, and from sixteen to seventeen acres are permanent grass lands.

Every part of the farm land serves at this time for some distinctly experimental purpose. Some experiments were inaugurated years ago, and the results become for this reason more important from year to year. The following short outline of the work of the present year can indicate the character of the experiments under way: —

1. The influence of different systems of cultivation and of manuring is tested in connection with different farm and garden crops, i.e.: —

a. The influence of the presence and absence of nitrogen in the manure applied is tested on leguminous plants. (Field A, soja bean.)

b. The economy of using soluble and insoluble phosphates on the basis of an equal money value per acre for the production of farm crops. (Field F, serradella.)

c. The influence of different forms of nitrogen and of potash on the quality and quantity of farm and garden crops.

d. The relation of the composition of plants to plant diseases. (Vegetation house.)

2. Among general farm crops, forage crops, in particular annual leguminous forage crops, have received special attention. Among them are some reputed forage crops new to our section of the country. To test their degree of adaptation to our climate and soil, as well as their general economical value under our market condition of fodder articles, has been our aim: summer vetch and oats, Canada peas and oats, several varieties of soja bean, serradella, Southern cowpea.

Some of these have been fed as green fodder, or as hay, or as ensilage, or in all three forms, as a rule with much satisfaction.

There are several silos, filled with mixed forage crops, on hand, viz., soja bean and fodder corn, serradella with Hungarian grass.

The field experiments are in several instances accompanied with observations in the vegetation house.

Our meadows are top-dressed either with barn-yard manure or bone and muriate of potash, or wood ashes.

III. On the Work in the Chemical Laboratory of the Station (1892).

The work performed in the chemical laboratory is quite extensive and in various directions, and is steadily increasing. The analyses arising in connection with investigations carried on in the vegetation house, the field and the barn of the station, are quite numerous. The analyses of fertilizers, fodder articles, well water, etc., made at the request of farmers and farmers' clubs, are of daily occurrence. Aside from these current sources of work, much responsible work has to be carried on in the line of the official analyses of commercial fertilizers and of imitations of butter.

Secretary SESSIONS. We have another subject for this forenoon. We have just about half an hour that we can allow for it. The gentleman who is to speak to us has enough to tell us to take a couple of hours, I have no doubt, and it is probably best that he should begin now, so as to save all the time. I think, Mr. Chairman, you had better call on Mr. STOCKBRIDGE. I am sorry our time is so limited.

The CHAIRMAN. Gentlemen, I have the pleasure now of introducing to you Prof. Levi STOCKBRIDGE of Amherst, chairman of the Cattle Commission, who will talk upon the "Work of the State Cattle Commission."

WORK OF THE STATE CATTLE COMMISSION.

BY PROF. LEVI STOCKBRIDGE, CHAIRMAN.

Mr. Chairman and Gentlemen of the Board of Agriculture*: — I deem it fitting that a representative of the Cattle Commission should come here and speak of the work of the commission, and especially so because the Commonwealth of Massachusetts is indebted to the efforts and the influence of this Board for the formation of the Cattle Commission, and for the fact that we have had any legislation for the purpose of suppressing contagious diseases among our domestic animals.

Now, you will please excuse me if I say a word about the history of this legislation and the history of the diseases among our cattle, for reasons which I will show before I close. Our first legislation was in the year 1860. The cause of that legislation was the bringing into this country from Holland of two Holstein, or, as they were then called, Dutch cattle, which, when landed in Massachusetts, were found to be both sick with some disease almost unknown, practically unknown to all the veterinarians we had in the State at that time as a disease which they had ever handled or seen, although as educated men they might know a good deal about it from the books. These two animals went to a town near Boston, and were put into a large herd of the same kind of cattle. Both of them soon died, and in the course of a month, or a little more than that, other cattle in the herd were found sick, exhibiting the same symptoms that the originally imported cattle exhibited. This importation was in June, 1859. A few animals were scattered in the adjoining towns from where these cattle were first placed, and one poor calf was taken from there to Brookfield. In

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* Stenographic Report by C. E. Barnes.

Brookfield that calf came in contact with some two or three large herds of cattle, and these exposed animals soon after came in contact with the cattle of quite a large section of country in and around the Brookfields. The disease developed rapidly, produced great losses at once, and the people became very much alarmed. The inhabitants of Brookfield petitioned the Legislature for some sort of legislation which would enable the city or town to control the disease, and this petition was most thoroughly backed up and supported by the Board of Agriculture. The result was that in April the old original cattle commission law, or the old original law for the suppression of contagious diseases among cattle, was passed, and a small appropriation made to pay the expense; and, if I remember rightly, Paoli Lathrop of South Hadley, Dr. G. B. Loring of Salem and Amasa Walker of Brookfield were appointed as these commissioners. Immediately on receiving their commission they made a survey of the field which was infected with the disease, and were appalled to find the condition that existed. They saw at once that under the provisions of the law as it was passed it was utterly impossible for them to combat the disease. As you doubtless remember, the law was that a herd that had become contaminated with the disease, where a single animal was sick, whatever was the condition of the remainder of the herd, that whole herd should be slaughtered. Remember this was the stamp-out policy; it was the only true one. The whole herd should be slaughtered, and the State would pay for all the well animals, all found healthy after killing. The commissioners found that the appropriation was not large enough for them to begin to do the work. Rather than have it stop, some members of the Board of Agriculture contributed largely to provide money that the work might go on. The old Massachusetts Society agreed to pay two thousand dollars for the same purpose, but as the commissioners worked, the thing enlarged and enlarged until they found it was clearly beyond any possibility of private individuals paying the expense of stamping the disease out, and therefore a special session of the Legislature was called, which met in the same season, in the month of May, and a much larger appropriation was made, and then the work went on.

Now, this appropriation enabled the commissioners to kill the leading herds where the disease existed, but there were threads leading out from these places where cattle had gone that had not yet been found, and where it was altogether probable that the disease would still be found to exist; and these facts were reported to the Legislature of 1861 in the annual report of the Cattle Commissioners, but the Legislature in its wisdom decided that it would make no appropriation that year; it thought that what was left of the disease in the State would doubtless die out, and no appropriation was made, and as a result the Cattle Commissioners resigned. The disease did not die out. It was found existing in the State in secluded spots, and in 1862 the Board of Agriculture — now you mark, gentlemen, this law comes back to the Board of Agriculture — the Board of Agriculture memorialized the Legislature, setting forth the facts in the case, and asking for another appropriation for the purpose of finishing the disease. An appropriation was made; the work went on, and the Cattle Commissioners made their annual report in 1863, and said, "It is very doubtful whether we have killed out all the threads of the disease that have been scattered through the Commonwealth," and they asked for another appropriation. The Legislature in its wisdom refused to make the appropriation in 1863, and the Board, of course, resigned; but in 1864 the Board of Agriculture, not satisfied, memorialized the Legislature again, and an appropriation was made, new commissioners were appointed, and the work went on. The commissioners reported in that year, 1864, that it was doubtful whether the disease was absolutely stamped out. An appropriation was made in 1864, and again in 1865, but after 1864 the Cattle Commissioners reported that from 1864, that is, in 1865 and 1866, not a case was found in Massachusetts, and all the threads of that disease had been traced out. The last diseased cattle found were just over the line in New Hampshire.

Now, then, let me make this statement, because I find that the people of the Commonwealth, the farmers of the Commonwealth, have not taken it in fully. There has never been a case of contagious pleuro-pneumonia in the State of Massachusetts since the year 1864. That ended it; it was stamped out. The work of stamping it out cost the State of Massachusetts pretty nearly a hundred thousand dollars, but it cost private individuals a very much larger sum. Thus much for that first contagious disease, and for the action of the Board of Agriculture in relation to it.

The commissioners resigned, and we went without a commission until 1868 (it was during Governor Bullock's administration), when one day there went out from the governor to three gentlemen in this Commonwealth a simple notice like this: "You have been appointed a Cattle Commissioner. You must leave home immediately and come to the governor's department at the State House;" and the three gentlemen were there immediately, as quick as the train could come, and this information was given them: "There seems to be a terrible disease all along the line of cattle transportation. As far as we know, cattle have been coming into the Brighton market in a condition little better than dead. Large numbers have been killed soon after coming into the market;" and he said, "Last night a train load of cattle came into Brighton with many dead cattle in the cars, and others so sick that they could not get up. Every dead one and every sick one was dressed last night, and was sold in Quincy market this morning, and something must be done. It is a new thing, and nobody knows anything about what it is." The commissioners then appointed took their oath of office and started out immediately, going to Brighton, and took a survey of the whole field, and finally found that they must go to Albany, and there make an investigation. It was done, and they found that in the cattle yards at Albany they had six hundred sick cattle that were being killed as fast as they could be killed by two or three gangs of men, and taken to the bone-yards, where they were disposed of, and there the commissioners learned that this disease was all along the line of cattle transportation from Kansas to Brighton. It was Texas or Spanish fever. The whole country was alarmed. It seemed to be the duty of the Cattle Commissioners to guard Massachusetts from the hordes of cattle that were coming on; and all we did there was to make an arrangement with the Boston & Albany Railroad that no cattle should be received upon their trains unless they came with the certificate of the Cattle Commission that they were perfectly healthy. Then we went to work on the lines where it had started among our herds in this section from around Brighton. A Texan coming directly from the plains, to all appearance perfectly healthy, perfectly healthy by post-mortem examination, coming in contact with native cattle, or the native cattle passing over the ground where the Texan had walked, or confined where a Texan had been placed, would be almost sure to develop the disease, and more than eighty-eight per cent of those diseased cattle died. We found that the Texan gave the disease to the native cattle, but the native cattle could not give the disease to the other natives; therefore the thing we had to do was simply to shut out the Texans, and if we could do that then we would be all right. That we did, but there were so many cattle on the line coming through that we had the disease in 1869 and 1870. Then we got complete control of it. There was no more disease until 1873, and in 1873 and 1874 the disease made its appearance again, and we discovered that during this interim the lines of railroad had been extended in the far West clear down until they struck the Texas line, and those cattle could be shipped from Texas, confined in the cars and cattle yards, and they did not come in contact with the native cattle until they came into Massachusetts, when they brought the disease to various places, and we had the plague again. If I remember rightly, the last we had to do with that disease was in 1876, when we had the law passed by which we could shut the cattle out effectually. The law was passed that no Texan cattle should be received into the State of Massachusetts between the first day of May and the first day of November. It was a little crooked, as a matter of law, but, however, they were effectually shut out, and this provision was made, that if we caught any of them, they should not be driven on any street in Massachusetts, they should not be put into any pasture in Massachusetts, but taken from the cars and slaughtered where they landed. We have not had a case of Spanish fever since, not one. So much for that. The State was a very great loser by that disease, but the fact that was learned by the Cattle Commissioners was taken advantage of, and the thing was cleaned up.

By chapter 24 of the Acts of the year 1878, glanders was made a contagious disease that should be cared for by the Cattle Commissioners. Now, gentlemen, I hardly know what to say to you about that. From the day that the Cattle Commissioners began their work in trying to eradicate glanders, until this very hour, we have not succeeded in doing it. It has increased upon us. The first year that we handled the disease I think we killed but ten, but the number gradually came up to thirty and forty and fifty, and it has continued on the increase in spite of all we can do, until to-day. I suppose that when our annual report of this year comes out it will be found that we have killed more than one hundred this present year.

Now, you may ask the question, why? And I can only tell you this. There are two reasons for it. In the first place, we have a good many more horses in Massachusetts to-day than we had. In the next place, our people are shipping horses all the time from the West, and we can not well prevent it. Then there is another trick. We have insurance companies in Massachusetts that are insuring animals. There is a set of scalawags in this State who go outside the State and find a good-for-nothing horse, that is, a horse that has got a little past its time, and has the first symptoms of glanders, and they will buy him for a small sum. They will bring him into Massachusetts and clean him up, and then go to one of the agents of these insurance companies and get the horse insured for a hundred or a hundred and fifty dollars, — and I have known of cases where it went higher than that, — then in a little while word is sent to the Cattle Commissioners of a suspected case of glanders, and when we come and inspect the case, we find it is glanders. The horse is killed, and this fellow pockets the one hundred and fifty dollars from the insurance company for what cost him perhaps fifteen or twenty.

Question. You do not pay anything for a glandered horse?

Professor Stockbridge. No. There has been a set of men in Worcester who have been doing this kind of business, and we have been killing horse after horse; after a while the members of the Board caught onto the trick and notified the insurance companies of what was going on, and it is my impression that kind of business will be stopped very soon. This much, gentlemen, for glanders.

I do not know but I am taking too much time on these different diseases, but the next disease I want to speak of is the foot and mouth disease. I do not know whether any of you ever had a case of foot and mouth disease among your herds.

A MEMBER. My father had fifty.

Professor STOCKBRIDGE. He did, I know. I went there and found it. It made its appearance here in 1878, and it was all through the State. It is a peculiar disease. It incubates in from three to eight days, and I will give you its history in this State. This was the only time that this disease has ever been in America. There were afterwards a few cattle imported from abroad and landed in Maine, but they were seized and quarantined there immediately, so that the disease was stamped out, and they did not give the disease to any native stock; but in the case that I speak of the animals were imported to Canada, — choice thoroughbred cattle. They were found to be infected with this disease; nobody knew what it was. It was scattered through quite a wide section of country in Canada, and then it went down to Albany, and went from Albany all through this State, a good deal of it on the cars; but the farmers in the Hadleys and the farmers in Berkshire County went to Albany and bought their winter stock, and in the month of November it made its appearance in this way along through western Massachusetts and out from Brighton, wherever the cattle went through, nobody knowing what was going on before word came to the commissioners. The disease appeared in eighty different towns in the State, and it was on something like three hundred farms, and nearly four thousand head of cattle had it. It cost the State and private individuals more than one hundred thousand dollars.

QUESTION. Was it a fatal disease?

Professor STOCKBRIDGE. We did not call it a very fatal disease. There were only about thirty animals that died, but it ruined hundreds and hundreds of cattle, for after recovering from the disease they were practically good for nothing. Their milk dried up immediately; they could not recover from it, and that made a great loss, although there were but few that died. Now, in treating that disease we first tried absolute isolation. Everything was shut up. Cattle were not allowed to be driven along the highway at all, and we hardly allowed a man to use his oxen on the farm. Everything was closed. You may say there was practically a quarantine of all the moving cattle of the State. The next thing was to purify the cars that brought cattle from the West. The next thing was to purify Brighton, because the cattle infected with this disease had been driven there; and all the sheds and barns were purified, along all the highways and driveways to Brighton, wherever cattle went with the foot and mouth disease and had left the trail behind them. It was so very contagious that an animal just driven across the road where those diseased cattle had passed would be sure to develop the disease. It would break out in from three to ten days. The Cattle Commissioners bought six hundred barrels of carbolic acid, and we compelled the Boston & Albany Railroad, although they were willing to do it, to have every car that came in loaded with cattle thoroughly cleaned out, and then saturated it with carbolic acid. We did the same thing to all the sheds and barns at Brighton, and we induced the farmers who had the disease on their premises to use the acid, and use it freely. In that way we stamped out the disease, and there has not been a case in Massachusetts since. This much for the foot and mouth disease. I won't stop to speak about the symptoms, for I hope you will never see it, and so will not need to know anything about it.

The next disease that came to our attention was hog cholera. The first case of what is called hog cholera appeared in the State in 1881, — I mean since the existence of the Cattle Commission. There were cases away back in the old time at a remote date. In 1881 there was one case, a very, very bad case. It caused very great loss in one valuable herd of seventy-five thoroughbred Chester swine. It was brought to that herd by swine going to be slaughtered at Squire's establishment. They got loose, and were put into the premises of the man that owned the swine. We did not have another case for two years, and then all at once we found that wherever they were bringing dressed meat in this State, hog cholera was making its appearance in the surrounding country. It was an enigma. Holyoke had one of those establishments, and we found hog cholera in all the adjoining towns. It was so in the eastern part of the State, it was so in central Massachusetts. Worcester had it at the State hospital and at the city poorhouse establishment; the hogs were all infected with it, — and "Where did they get it? Where did it come from?" was the question. A long and very thorough examination finally developed this, — and I won't go on and tell how we knew, it will take too much time, — that this dressed meat that came from Chicago was bought and sold out by the various butchers. They carried that meat out without washing it, and that meat carried the cholera. We traced it, and ascertained certainly that that was the way the disease was disseminated through the State.

Now, then, these farmers are pretty good fellows, but after all they are pretty sharp with the Commonwealth of Massachusetts. Sometimes we found milkmen who were furnishing milk to the hotels and restaurants of our larger towns and cities, and who, in order to sell their milk to these establishments, were obliged to take their swill. The result of that was that almost all these fellows had hog cholera among their swine; and the Cattle Commissioners went there and cleaned them up in the good old-fashioned way, slaughtering all they had, and paying for the well ones; and the man having had that lot cleaned out would go right off and buy some more, and feed them with the same kind of swill. Then the Cattle Commissioners would go and kill them off again, and he made a very good thing out of it; until finally we made this regulation, which was sent out to all the boards of health, that in all cases of hog cholera, after the owners had been thoroughly warned, the boards of health should immediately proceed to isolate and thoroughly quarantine those premises, to kill none, but let the man have the hog cholera just as long as he wanted to, and when he got sick of it he would stop feeding swill. We have had nothing to do with it since, and that was in 1886. That finished the hog cholera.

Now, the next disease that I wish to speak of is tuberculosis. You have all heard of that disease. You will remember I said that contagious pleuro-pneumonia went through the State, and that the system adopted was to stamp it out by killing, which worked well. It was a lung disease. The consequence was that it became difficult to get it out of the minds of the farmers of this Commonwealth that an animal that had any trouble with its lungs did not have pleuro-pneumonia. We have not had a case in the State since 1864, but the boards of selectmen of some towns, right after they had had our reports, would report a case of contagious pleuro-pneumonia. The consequence was that the Cattle Commissioners were under the necessity of visiting many of these places, to allay the excitement. There would be some farmer, it might be in Berkshire County or Worcester County, that would report he had a case of contagious pleuro-pneumonia. The whole community were alarmed. The commissioners would go there and make an examination, and they would find ordinary pneumonia, or what we then called consumption. We had not got so big in words then as to call it tuberculosis, and we killed a good many cattle that had that disease. I do not know but I can say that we killed cattle in almost every county in this State, but they were not cases of contagious pleuro-pneumonia, they were consumption.

Now, I am telling these things in this particular way because of many things that have been said within the last year. Finally, it came to pass that the Cattle Commissioners thought it important that the attention of the public should be drawn to it in our annual report. I may as well say here as to say later, that the Massachusetts Cattle Commissioners and the people of Massachusetts have not been going on blindfolded, utterly regardless of this disease, doing nothing, gathering no information, and letting it run round through the State. If anybody will take the pains to look the matter up in the reports, you will find that in the report of the Cattle Commissioners made in the year 1880 they dwelt particularly upon this disease, and told the whole story of it, — how it was found, where it was found, how it was developed, and what would probably be the result; and that report was made before some of these men — who know so much in these modern times — had their eyes opened to the fact that there was any such disease. There was a full report made in that year. They reported again upon it and discussed it at length in 1886, again in 1887, again in 1889, and again in 1891, detailing the whole thing. It will all be found in the agricultural reports of Massachusetts. By and by it began to be called tuberculosis. What have the Commissioners done with reference to it, and if we have not done anything, why? Now, mark you, gentlemen, this is a lung disease, but it is utterly unlike contagious pleuro-pneumonia. In these modern times it is regarded as contagious, but utterly unlike pleuro-pneumonia in its contagiousness. The germ or bacillus of tuberculosis has little virility, as compared with contagious pleuro-pneumonia. As I have already said in relation to that disease, the passage of an animal along the street, the passage of an animal near where they come, even with a fence between them, will convey that disease to a whole herd. A little calf went to North Brookfield and passed through two barns, and he gave the disease to forty or fifty head of cattle in each barn.

Now, then, here is a disease where, to the knowledge of the Cattle Commissioners, an animal might have it in a barn with other cattle, standing with an animal on each side, herded in the same yard or feeding in the same pasture, in constant contact, and not another animal of the herd take the disease. It is of very low vitality. Therefore, to apply the law of contagious pleuro-pneumonia to this kind of a disease, although we admit it is contagious, would be to waste millions of money, and to produce no good result; for, mark you, tuberculosis is everywhere. I would not be surprised to know that there is a case in this room. It is the same thing in men as in animals, and goes the same way, from animal to animal, from man to man, from men to animals. Perhaps there is a little more danger of its going from cattle to humans, because of the consumption of milk by the human family; and yet it is a disease which, although contagious, is of such low vitality that it should not be treated by the slaughter of whole herds as contagious pleuro-pneumoma was treated, especially when we know that you could not refill a barn after you had taken the cattle all out, without a very great probability that you would bring some more with the disease right into it, — it would not do to handle it that way.

Now, let me give you an illustration. Without calling names, one of the members of our Cattle Commission went into a herd of seventy-four or seventy-five cattle a little while ago, — magnificent animals, many of them imported, — and found there a case of tuberculosis. Under the old system that is advised by the modern men who know so much, the Cattle Commissioners should have gone there and killed the whole seventy-five, animals that were worth from one hundred and fifty dollars to two hundred dollars each, because there was one case there. If you had let them stand there without taking out the one infected animal, another case might not have occurred for the next five years, and therefore the Cattle Commissioners took this ground. The best thing we can do to eliminate this disease is to protect our herds as far as we can by taking out the diseased animals and killing them, thus saving the herds that are making milk for human beings; cleaning them out, but not spending money to stamp out the disease as contagious pleuro-pneumonia was stamped out. The Cattle Commissioners recommended that course, and they asked the Legislature in three or four different years to pass an act that would enable them to go into a herd and clean it the best they knew how, beginning with the worst case and going along up further where there was less and less, and, if we happened to kill one that was not diseased, then the State should pay for it. That is what we asked, and we only got a law passed to that effect in 1891.

Now, a few points more, gentlemen, as I must hurry on. I have some notes here now that I want to call your attention to, and I do this in consequence of the many things that have been said about Massachusetts within the last year or year and a half. Massachusetts passed the first law that was ever passed in America for the destruction of contagious diseases among domestic animals, yet people talk about Massachusetts knowing nothing and doing nothing. Massachusetts passed the first law and made the first appropriation, expending thousands and hundreds of thousands of dollars before any other State in the Union had any legislation on the subject of contagious diseases among cattle. So much for the honor and credit of Massachusetts.

Another thing. Wherever there has been anything done in this line, the best thing that has been done has been where they have followed the track of Massachusetts; and from Massachusetts they have obtained a large share of all the intelligence they have had in relation to handling these diseases by law. Why, the State of New York had contagious pleuro-pneumonia in the '40's, and yet it never made any attempt to stamp it out as Massachusetts did. The State of New York, I think, up to to-day has never had a board of cattle commissioners, nor taken any action in this direction. But the disease spread from New York. It went to New Jersey, it went to Pennsylvania and Maryland, it went to the District of Columbia, it went to Virginia, and finally it began to travel West, and began to get in among their thoroughbreds and improved cattle. It travelled until it got to the Mississippi River, and the whole world was in arms in relation to it; for, if the disease should once get on the great ranches in the far West, the loss would be untold millions, and therefore the State of Illinois woke up. There were great cattle markets at Chicago, and they said something should be done by the State. They only volunteered to help the United States government, which took hold with the State of Illinois and stamped it out; and then the United States government, following the track of Massachusetts as far as it could, went to work and attacked it in every State where it existed. They ransacked the State of New York, the State of Pennsylvania, and other States, and ferreted out every case of contagious pleuro-pneumonia they could find; bought the cattle outright, the government paying for them, and then killed them all; and within the last four months Secretary Rusk has published to the world that the last case of pleuro-pneumonia in the United States of America has been stamped out. Uncle Sam followed Massachusetts, and learned from Massachusetts how to do the work he has done for the Union.

Massachusetts has not such a bad climate; we are not so filthy; we are not so utterly regardless of hygienic principles, that all these diseases generate in Massachusetts. This is not a home of disease. The animals as a general rule are in pretty good condition. Hygienic principles are as much regarded in Massachusetts as they are anywhere else. The diseases that have plagued us have been imported to us rather than generated here. Where did contagious pleuro-pneumonia come from? It came to us from Holland. Where did the Texas or Spanish fever come from? It came to us from Texas. Where did the hog cholera come from? It came to us from Chicago. Where did the foot and mouth disease come from? It came to us from Canada. We met these diseases as soon as we could find them. Massachusetts was prompt in her preparation, and we have protected ourselves against those diseases, stamped out most of them; and the rest of the Union and the United States government, just following in our track, have done the same thing.

Tuberculosis never was stamped out, and we never shall stamp it out. As long as it exists in the human family it will exist in our bovines; and if Massachusetts was to-day to kill every bovine and clean the whole State up with copious supplies of all the disinfectants we know, the very first time we undertook to fill our barns with stock from anywhere we should undoubtedly bring in tuberculosis with the stock. It is in Maine, it is in New Hampshire, it is in Vermont, it is in Massachusetts, Rhode Island and Connecticut; and I know of my own absolute knowledge, having seen it there this year, it is in the West. There are certain places where it is more rife than others; and all the Cattle Commissioners can do and all you can do is simply to eliminate it, lessen it, so as to purify our herds, and as far as possible to prevent the sale of milk that shall come from a herd where one single animal is infected by it, and prevent the sale of carcasses of animals for beef when found by *post mortem* examination to be affected, and to see that such carcasses are destroyed

The question might be asked, Is it very dangerous to eat this beef? No, do not be concerned if you should find that you have eaten a little tuberculous beef; do not be concerned, if the beef is well cooked, the cooking will kill the germ, and there will be no danger whatever; but, after all, we do not any of us hanker after that sort of beef, and we always advise to let it go into the rendering tank; let it be made into fertilizer.

Professor BROOKS. Mr. Chairman, I want to say a word in connection with tuberculosis. It may do something to allay excitement and fear from the danger of using milk, etc. I see the statement repeated, it crops out again and again, that tuberculosis or consumption in the human family is known only where milk is used as human food. I know of my own observation that this is not the fact. I lived for twelve years among a people, the Japanese, of whom consumption carries off as large a proportion as it does here, and they never use the milk of cows as human food.

Adjourned until 2 P.M.

AFTERNOON SESSION.

The chairman called the meeting to order at about 2.30, and said: Gentlemen, the subject to which your attention will be first called this afternoon is "Work of the State Dairy Bureau," which will be presented by Mr. GEORGE M. WHITAKER, assistant executive officer, whom I have now the pleasure of introducing to you.

The lecture of Mr. Whitaker, being in substance the forthcoming annual report of the Dairy Bureau to the Legislature, is omitted from the proceedings of the public winter meeting. The annual report of the Dairy Bureau will be found as a special report to the Legislature, following the report of the Gypsy Moth Committee.

The CHAIRMAN. Mr. Wm. Bancroft of Chesterfield I believe wished to make a motion at this time, and I will ask the secretary to read it.

Secretary SESSIONS. Mr. Bancroft moves a vote of thanks to Mr. Arthur W. Hoyle, an enthusiastic young florist of this town, for his voluntary ornamentation of the platform during this session; also to Mr. John D. Avery, our late associate, for his kindness and untiring efforts in contributing to our pleasures and comfort; and our thanks will be incomplete unless they include the great courtesy extended us last night by our generous entertainers, Mr. and Mrs. Chas. N. Prouty, and the citizens generally of Spencer.

The motion was adopted unanimously by a rising vote.

Secretary SESSIONS. Mr. Chairman, I would suggest that our friend Mr. Avery inform Mr. Prouty of the action of the meeting.

The CHAIRMAN. The Chair will request Mr. Avery to inform the gentleman of the action of the meeting.

Mr. AVERY. Mr. Chairman, when I extended the invitation to the State Board to meet here, several members of the Board approached me and asked me where Spencer was, and how they were going to get there; and I began to think they feared they would meet with the experience that we read the man did in sacred history that went down to Jericho. I hope those men are happily disappointed. If we have done anything to make your stay here pleasant and agreeable, we feel as though we had only done our duty. Mr. Prouty said to me at noon down at the hotel that if the State Board would come here another year, as we had just had a taste of them, we would fill this hall to overflowing.

The CHAIRMAN. Gentlemen, the next paper to be presented to-day is upon the "Work of the Gypsy Moth Committee," and I now have the pleasure of introducing to you Mr. E. H. FORBUSH, the director of the field work.

WORK OF THE GYPSY MOTH COMMITTEE.

BY E. H. FORBUSH, DIRECTOR OF FIELD WORK.

For centuries crusades have been carried on in European countries against certain species of animals harmful to agriculture. In early times kings required annually, as a part of the taxes from each land holder, a stated number of heads of animals whose destruction was considered desirable.

In this country inducements in the shape of cash bounties have been offered by many States for the heads, hides or scalps of rapacious mammals, and for the heads of birds supposed to be injurious. I am not aware, however, that any attempt has ever before been made by a State government to eradicate an insect pest which had obtained a foothold by a twenty years' residence. Neither am I aware that such a task has ever before been delegated by a legislative body to a State department, and yet this plan seems the only one which promises success. It leaves those in charge of the work unhampered by personal or political considerations in their choice of men and means, and demonstrates the wisdom displayed by the Executive and Legislature of Massachusetts in placing such a work in the hands of the State Board of Agriculture. The Board has wisely chosen men of ability and foresight as a committee to have charge of the work, and the committee has selected as entomological adviser a man whose eminent scientific qualifications are equalled only by his practical experience and knowledge of affairs. It must be granted, then, that the undertaking was begun under the most favorable auspices. But I am here to speak of its progress, and the prospects of ultimate success.

Money enough has been appropriated by the Legislature the past two seasons to provide for an inspection of the infested region, and to test some of the principal means of control and destruction which have been utilized in this country and in Europe for this and similar insects, and these have proved utterly inadequate. While this was being demonstrated, experiment, observation and invention were supplying us with new resources, and soon extermination by localities became not only a probability but an accomplished fact.

Twice the success of the undertaking was endangered by a lack of funds, and this has been the most discouraging feature of the case. It may be said that your committee should have asked for more means; but it must be remembered that the area infested was found to be at least eight times as great as was at first represented, and that in view of subsequent developments the committee could not possibly have estimated the expense accurately beforehand. As many means of destroying the moth have been tried, and a few have proved useful and may assist the farmer in dealing with other insects, I will briefly describe some of them.

Spraying with Arsenites.

At the first meeting of the present management the opinion of the majority of the experts called in was that extermination could be secured only by spraying with arsenites. This method had also been recommended to the original commission, and I presume there never was so much Paris green used for such a purpose in two seasons, under one management, as has been used within the limits of this infested district. Altogether some three and one-half tons have been sprayed over those devoted towns. The experiments which had been made with Paris green and London purple resulted in a verdict in favor of Paris green, as it gave the more uniform results and was less injurious to the foliage. The effect of these poisons on the caterpillars of the gypsy moth was not uniform, but it may be stated as a rule that both destroyed the young caterpillars, but failed to kill those that were larger and more vigorous. Critics may say that the poisons were adulterated, that they were carelessly or improperly applied, and that for these reasons the older caterpillars were not killed; but our Paris green was several times analyzed, and proved to be the equal of any in the market. While the spraying did not kill all the gypsy moth caterpillars, it did kill other insects on the same trees. Yet a grove of trees that was twice sprayed with Paris green of a strength of one pound to one hundred gallons of water was afterwards entirely stripped of its leaves by these caterpillars. Many died, yet after the trees had been stripped and the insects had pupated, one man gathered one thousand one hundred and sixty-five living pupæ in an hour under these same trees. In another instance the same experiment was tried on a larger scale, with similar results.

Other insects were killed in great numbers by the spraying in this district, and it was noticeable that never had the trees been so free from insects as in the season of 1891, and never had the crop of fruit been so large and of such good quality. Many people who were at first prejudiced against the spraying afterwards testified to these facts. One of my neighbors who had lost many leaves from his trees through the spraying expected to lose the entire fruit crop; yet his crop of apples so far exceeded his expectations that he was unable to gather them all, and sold the remainder on the trees. He told me that the fruit was all large and fair, with the exception of that on one tree which was not infested and had not been sprayed, and that most of the apples from that tree were wormy and worthless. Certain trees appear to be more susceptible to arsenical poisoning than other trees of the same species, and certain species of trees are more susceptible than other species or varieties; therefore a spraying of a strength that will not injure one tree may injure another.

As at one time two hundred and forty men were at work spraying, there was undoubtedly some carelessness and occasionally a tree was injured; but I know of no instance where permanent injury has been observed as a result of the spraying.

Much has been said about the danger to animals from this spraying; but it is hardly possible that the infinitesimal quantity of arsenic which is distributed in this way on each tree or plot of grass could injure an animal of any size. I have, however, noticed the sudden demise of several flocks of hens, and this demise was quite frequently coincident with the spraying. One of the hens, however, was examined, and no trace of arsenic was found in the stomach. Some of these hens may have eaten poisoned grass in sufficient quantity to destroy them, but we have no conclusive evidence that such is the case. Hens also eat great numbers of the caterpillars when they can find them, and it may be possible that their death was hastened by eating poisoned caterpillars.

Most absurd and ridiculous statements have been circulated, to the effect that horses and cattle have been killed by eating grass and leaves which we have sprayed; also that people have died from chewing leaves sprayed with Paris green, or from having Paris green sprayed over their food. To show how far people may be deluded by their prejudices, I frequently allowed a horse to feed upon grass which had been sprayed, and from the effects of eating which horses and cattle were said to have died, and this horse has never shown any symptoms of arsenical poisoning.

The mixture ordinarily used was slightly stronger than that recommended for spraying fruit trees for the destruction of other insects, and was almost uniformly as follows: one hundred and fifty gallons of water, one pound of Paris green and two quarts of glucose. It was seen that Paris green when used alone was washed off the leaves by sudden showers. A small quantity of glucose added to the mixture will hold the poison upon the leaves during a hard shower, and in our experience it has proved to be far more useful than anything else tried. It is inexpensive, costing two and five-eighths cents per pound by the barrel.

Destroying Eggs.

Under ordinary circumstances the most effective and cheapest methods of destroying the eggs are to burn them or to saturate them with creosote oil by means of a sponge or brush. This oil is made by the Carolina Oil and Creosote Company of Wilmington, N. C., and is sold at fifteen cents a gallon by the barrel. It penetrates and kills the eggs at once.

For reaching eggs in hollows or cavities of trees, and other inaccessible places, bromine is used. This can be injected into the cavity, and soon forms a gas. The cavity is closed, and the gas destroys all animal life.

Banding Trees.

As a preventive measure, banding the trees with mixtures which the caterpillars cannot cross is effective, with this as well as other insects. The method used in 1891 was an improvement over the ordinary method of banding trees to prevent the ascent of the canker worm. A coating of cotton waste was placed about the trunk about five feet from the ground; a band of tarred paper was bound on this by a cord which drew it close to the tree; the upper edge of the paper was then tacked to the bark. The paper was covered with a mixture consisting of two parts of tree ink or canker-worm exterminator, one part pine tar and one part residuum oil (a product of petroleum). This will prevent the caterpillars from ascending the trees, but must be renewed often to be effective. If the strips of tarred paper are put on in this way and kept wet with the mixture, they not only prevent the ascent of caterpillars, and trap many of them, but they stop the canker worm moths and the young canker worms. Insects cannot crawl over or under these bands if they are properly applied and kept constantly moist.

In 1892 the committee procured for this purpose four tons of "Raupenleim" or insect lime, which is prepared by certain firms in Germany, and has been used in that country for some years for protecting forest trees from this and allied insects. This lime was recommended by Professor Fernow and Dr. Riley, both of the United States Department of Agriculture, and was imported for the committee by the Bowker Fertilizer Company of Boston. When once properly put on it remains in a soft and viscous condition for at least two months. This lime is inexpensive and easily applied. The bark must be scraped or planed down to make a smooth surface some five inches wide, extending around the trunk, and high enough from the ground to be out of reach of sheep or cattle if they are pastured near by. On this surface the lime may be applied with a machine manufactured for the purpose, or with a trowel, and must be laid on heavily, otherwise too much of the oil contained in it may be absorbed by the bark. It will prevent an invasion of any crawling insect, and may be relied upon to protect the trees not only from canker worms but from other insects that ascend the tree in the same manner.

Burlap Bands.

During the season of 1891 it was observed that when the caterpillars were half grown they began to feed at night, and clustered during the day on the lower sides of limbs, on the shady sides of trunks of trees, or in cavities or crevices in the trees or objects near by. It was also noticed that at this time they sought hiding places, and that any piece of old carpet, bunch of hay or strip of cloth wound around or thrown on the tree was used by them as a place of concealment. It was seen that any artificial shelter which they would seek could be made an effectual trap for them. Experiments were made with sundry fabrics, and it was found that a band of coarse burlap bound loosely about the tree was the most effective trap that had been devised. Many of these were placed upon the trees during the season, and they were visited as often as possible. The caterpillars which clustered beneath them were killed, and the summer's increase of the moth was largely disposed of in this way.

Where the loose bark had been scraped off and hollows in which they had heretofore secreted themselves had been filled with cement, all the insects on a tree were frequently taken from under the burlap. This method was followed during the past season. In examining the bands it was noticed that many other species of insects took advantage of them, and apple worms, tent caterpillars, borers, leaf beetles and moths all sought these hiding places.

The inspectors report to me that many tree borers gather beneath the burlaps in the summer and fall, and that in some cases they are so numerous as to make a complete band of living insects extending entirely around the trunk. If the burlap is watched and the insects are killed it will greatly benefit the trees, and I urge you all to try the experiment. If you scrape the loose bark from your apple trees and then apply this band, I think you will be somewhat surprised at the number of injurious insects you will be able to catch and destroy, and you may thus prevent injury in the years to come.

THE CYCLONE BURNER.

The most effectual means of dealing with the pest in lands which have grown up to brush is to cut the brush with axes or scythes, sprinkle with oil, and burn brush, leaves and all vegetation. In this work the spraying pump is very useful. A portable tank is used, and a short hose terminated by a hollow pipe twelve feet long is attached to the pump. A Riley or Cyclone nozzle is used on the end of this tube, and crude petroleum is pumped through this from the tank. The fine spray of oil thus thrown is easily ignited, and makes a very hot volume of flame which may be run over the surface of the ground at will. Such an apparatus can be handled by two men, and would probably be useful in checking the invasion of such pests as the army worm. It was by the use of this machine that we checked the ravages of the moth in Swampscott, where all other means had failed. On level ground an apparatus having several nozzles could be mounted upon a wagon, and acres could be rapidly burned over in this way. In brush and on rough ground the oil was sprayed from a watering pot and burned afterward.

It must be evident to all that an intimate acquaintance with the territory infested, a study of the means of distribution and a knowledge of the habits and life-history of the moth, its parasites and enemies, are all indispensable prerequisites to an intelligent effort for its destruction. In the past two seasons we have tried to observe and record all facts bearing upon these subjects, and to obtain by comparison and deduction that exact knowledge which must be our guide; and yet there are some questions of vital importance which it will require the experience of another season to answer, and the committee is not yet ready to make a full report on the habits of the moth, its enemies and parasites. For such information as has already been published in regard to the work I refer you to the special report of this Board, which was made to the Legislature in 1892 and was published in the last annual report of the State Board of Agriculture; to a special bulletin published by the Hatch Experiment Station, at Amherst, in November, 1889, written by Prof. C. H.

Fernald; to Bulletin No. 19 of the Hatch Experiment Station, in which Professor Fernald gives a full description of the moth; and to "The Massachusetts Ploughman" of Saturday, April 9, 1892, volume LI., No. 28.

We find that many parasites and flesh-eating insects prey upon the gypsy moth, and that fowls and toads eat them; but it seems probable that we get the most efficient aid from birds. During the past two seasons the following species of birds have been seen to feed upon the caterpillars of the gypsy moth: —

1.	American robin,	*Merula migratoria.*
2.	Catbird,	*Galeoscoptes carolinensis.*
3.	Brown thrasher,	*Harporhynchus rufus.*
4.	Bluebird,	*Sialia sialis.*
5.	Chickadee,	*Parus atricapillus.*
6.	American redstart,	*Setophaga ruticilla.*
7.	Black and white warbler,	*Mniotilta varia.*
8.	Maryland yellow-throated warbler,	*Geothlypis trichas.*
9.	Oven-bird,	*Seiurus aurocapillus.*
10.	Yellow warbler,	*Dendroica æstiva.*
11.	Red-eyed vireo,	*Vireo olivaceus.*
12.	White-eyed vireo,	*Vireo noveboracensis.*
13.	Yellow-throated vireo,	*Vireo flavifrons.*
14.	Chipping sparrow,	*Spizella socialis.*
15.	English sparrow,	*Passer domesticus.*
16.	Yellow-billed cuckoo,	*Coccyzus americanus.*
17.	Black-billed cuckoo,	*Coccyzus erythrophthalmus.*
18.	Blue jay,	*Cyanocitta cristata.*
19.	Baltimore oriole,	*Icterus galbula.*
20.	Purple grackle or crow blackbird,	*Quiscalus quiscula.*

The following species have been seen to catch the moth: —

1.	Kingbird,	*Tyrannus tyrannus.*
2.	Phœbe,	*Sayornis phœbe.*
3.	Wood pewee,	*Contopus virens.*
4.	Chipping sparrow,	*Spizella socialis.*
5.	English sparrow,	*Passer domesticus.*

Twenty-four species of birds have been seen to eat either the moth, the caterpillar, the pupa or the egg. The only ones identified when eating eggs were the white-bellied nuthatch, *Sitta carolinensis*, and the English sparrow, though others have been seen to eat them.

The frequency with which the name of the English sparrow appears is a little misleading, and needs some explanation. While all our observers agree that the sparrow is by far the most common bird in the infested region, only five report having seen them destroying the moth, and two of these say that the birds seemed to kill it out of mere wantonness, and did not eat it. It is also true that the moth is very abundant in the cities and villages where the sparrows are most plentiful, and that the caterpillars, moths and eggs occupy the bird-houses and nests of the sparrow, where they and the young sparrows form a sort of happy family. This sparrow is evidently a friend of the moth, inasmuch as it eats but few, and drives away native birds which eat many. The English sparrow is by structure and habit a grain and fruit eating bird. The Almighty never created it to eat insects.

The robin, blue jay, blue bird, both cuckoos, the chipping sparrow, redstart, yellow warbler, the oriole and all three vireos have been seen to eat the caterpillar with regularity and frequency. It is well known that some of these birds eat hairy caterpillars; but it is somewhat surprising, when we consider the disagreeable nature of the hairy covering of this species, that such birds as the small sparrows, warblers and titmice destroy them in such numbers.

Several instances are known where isolated colonies of the gypsy moth have been apparently exterminated by birds. I fear that the valuable services of our native birds are not appreciated by the rural population, else the laws made to protect them would be more stringently enforced, and the birds would be fostered instead of being shot.

Results of the Work.

The statute under which this task was undertaken was entitled "An Act to prevent the spreading and secure the extermination of the ocneria dispar or gypsy moth in this Commonwealth."

So far as the first clause is concerned, we seem to have been entirely successful. Although many tales and rumors of its presence in other towns and cities have been published, they have had no foundation in fact. The insects referred to have always proved to be some other species, and, so far as we have been able to ascertain, the assertion that was made last year that the dissemination of the moth was stopped seems verified by the results of this season's inspection. The few years previous to the year 1890 were undoubtedly the years of its greatest spread.

The results of the work cannot be given here in detail, for lack of time, but may be stated in a general way. Fifty townships have been quite thoroughly searched, and the insect has been found in thirty of them. In some towns they have been locally exterminated, and in three they are entirely destroyed so far as we are able to determine by a careful search at the present time. Owing to lack of sufficient funds, we have been obliged to neglect certain localities and have been able to do all that was necessary in a few towns only. We have undoubtedly checked the increase of the moth, and have reduced their numbers ninety-nine per cent from what they were in the spring of 1890. It must not be forgotten, however, that it will probably take more time and cost more to find and destroy the one than it did to dispose of the ninety and nine.

The Outlook.

No one who has not had practical experience in this field can appreciate the extreme difficulty of carrying this undertaking to a successful issue. The first and greatest obstacle to success is our own ignorance; the second is the lack of funds necessary to take radical measures; the third is the prejudice of and lack of co-operation by the people in the infested region; the fourth, but not by any means the last, is the difficulty of securing trustworthy and competent men. We can now say with becoming humility that we are possessed of sufficient knowledge to use to advantage any amount of money that the Legislature may appropriate for this work; and yet we may be able at the end of another year's experience to use such funds to still better advantage.

When the Legislature was asked to make the first appropriation for the extermination of the gypsy moth, the insect was supposed to be confined to a strip one-half mile wide by two miles long, in the town of Medford. When your committee asked for its first appropriation in 1891, it was understood that the area occupied was possibly twenty-five square miles. In December, 1891, the creatures had been found scattered over an area of two hundred square miles, and it is not improbable that isolated colonies may yet be found outside of this limit. I do not wish to be understood as stating that the insects have spread since the beginning of our work, but that our search has resulted in finding them in the places which they had previously reached, and has stopped their dispersion wherever we have found them. But it must be evident to all that the amount of money that was deemed sufficient to exterminate them within an area of ten or twenty square miles is not sufficient to do more than reduce their numbers and hold them in check when used over an area of two hundred square miles. In consequence of this state of things, we have been unable to finish the work over a large area, as the men have been called from one locality to another by the exigencies of the case. If extermination is to be attempted, no such partial policy as this will ever succeed, and, if it is only intended to control the insects, that can now be accomplished at a less expense.

We have been advised to destroy them in the outer row of towns first, and then move in toward the centre; but, although this plan looks very well on paper, it is impracticable, as, if they are allowed to increase in the centre, they will spread to such an extent that they will soon be outside the line that has been drawn around them. Their increase must be stopped in the centre at all hazards, to prevent their spreading.

In conclusion, I will say that nothing like certain extermination is promised by any plan which may be proposed except the following: Means enough must be forthcoming to secure an adequate number of trustworthy men, such as are fitted by nature for the work. These men must be selected and trained. Each must have a certain section allotted him, for which he must be held responsible. Each man who fills all the requirements must be retained, if possible, for a series of years, on the same ground; he must have all the assistance he needs during the time the caterpillars are moving, that he may prevent their dissemination.

A corps of experts must be organized, whose duty it shall be to go over the work of the inspectors as often as possible, to detect carelessness or inefficiency. Such a number of foremen or superintendents must be provided as is found necessary to keep the entire field under constant supervision. If means enough are provided for this, and the work is properly conducted, the extermination of the gypsy moth is as certain as anything is in this life. Had we been provided with the means, we could have annihilated the insects in ten towns this year; the best we can now hope for is to accomplish this in the coming season. When that is done, the men at work in such towns should not be discharged, but should be concentrated in the centre, where it will take years to exterminate the last moth. Do not be deceived. No amount of money that the State can furnish will rid us of this creature in one year, or two; but its extermination is possible, and can be accomplished.

We have educated the men, we have invented the appliances, and we have the maps and records. We have advanced so far on the road to success that the contrast between the present condition and that of two years ago is surprising. We have the pest well in hand, and we need only the sinews of war to crush it.

At the conclusion of his paper, Mr. Forbush exhibited a specimen of the gypsy moth, and also photographs of its ravages.

The CHAIRMAN. Has any gentleman any question to ask Mr. Forbush?

QUESTION. I would like to ask him how wide this belt is, and whether it is more than one thickness, and how he fastens it around.

Mr. FORBUSH. I understand you to mean the belt of burlap. We cut it about one foot wide, place it around the tree, then put a piece of twine round it, and turn down the upper end so it will hang down something like the clothes on a clothes line.

QUESTION. What time is it put on?

Mr. FORBUSH. We put the burlap on for these creatures in May and June. The use of this burlap is nothing new, it has been recommended before. Although we thought we had discovered something, we find it has been recommended before, and has been in use more or less for over fifty years in other parts of the country.

QUESTION. Do I understand you that all the caterpillars in the tree will go down and hide under this band that you put about the trunk?

Mr. FORBUSH. We cannot state that definitely. We have in some cases taken all the caterpillars from the tree by putting on this band and searching it; but, if there are hiding places left up the tree which you have not taken care of, they may stay up in the tree and not come down, but generally some time in their lives they will come down. If they do not come down before, they will come down to pupate, and pupate under this band.

QUESTION. How often should it be examined?

Mr. FORBUSH. It should be examined every day. We have not done it, because we have not had men enough to do it; but it should be done.

Secretary SESSIONS. To how many trees have you applied it?

Mr. FORBUSH. I cannot give it exactly, because we have not figured up, a hundred thousand approximately, or more.

The CHAIRMAN. If no other gentleman has anything to say upon this subject, we will pass to the next subject, the "Work of the Board of Agriculture," which will be presented by WILLIAM R. SESSIONS, Secretary of the Board of Agriculture.

Secretary SESSIONS. I want to say, before I begin to read what I have written, that personally I am very much obliged to the people of Spencer and the surrounding towns. We have had a very successful meeting, one of the most pleasing to those who have had the work of arranging for it; and I think I may say for the Board of Agriculture that we shall go away with very appreciative feelings towards the town of Spencer and its people. For myself, I thank you heartily. In reference to the subject which has just been presented, if there should be questions you wish to ask Mr. Forbush or myself, after I get through, we shall be happy to explain the pictures and tell where they were taken, and other facts about them.

WORK OF THE BOARD OF AGRICULTURE.

BY WILLIAM R. SESSIONS, SECRETARY.

As long ago as 1796 boards of agriculture were officially recommended. Washington, the first President of our country, in one of his last messages to Congress, said: "It will not be doubted, that, with reference either to individual or national welfare, agriculture is of a primary importance. In proportion as nations advance in population and other circumstances of maturity, this truth becomes more and more an object of public patronage. Institutions for promoting it grow up, supported by the public purse; and to what object can it be dedicated with greater success than the establishment of boards composed of proper characters, charged with collecting and diffusing information, and enabled by premiums and small pecuniary aids to encourage and assist a spirit of discovery and improvement? This species of establishments contributes doubly to the increase of improvement, by stimulating to enterprise and experiments, and by drawing to a common centre the results everywhere of individual skill and observation, and spreading them thence over the whole nation. Experience accordingly has shown that they are cheap instruments of immense national benefits."

Here in a few words the father of our country outlined the object and duty of a board of agriculture. Massachusetts has for many years acted in accordance with the views of Washington in this matter. One of the first agricultural organizations in the country was the Massachusetts Society for Promoting Agriculture, incorporated in 1792. Between 1792 and 1818 several county societies were incorporated by the Legislature. In the latter year the Legislature provided for a system of bounties to these societies, which is still in force. But there was no connecting link between these societies; there was no way in which the experience of one could benefit the others; there was no supervision by which it could be known whether the State bounty was judiciously expended, or not. The officers of the societies conceived the idea of a Central Board of Agriculture, composed of delegates from the several societies. Such a Board was organized in March, 1851. This board was composed of good men, who were earnest to accomplish good results, but they had no funds for expenses and no power over the societies. They could only advise and recommend. The following year, upon petition of this central board, the Legislature established a State Board of Agriculture (April 21, 1852), to consist of the Governor, the Lieutenant-governor, the Secretary of the Commonwealth, one member chosen by each of the agricultural societies that received bounty from the State, and three members to be appointed by the Governor. The Board was authorized to appoint a secretary who should receive a salary, but the members were to serve without compensation except for travelling and necessary expenses while in discharge of duty as members of the Board.

The Board was organized July 22, 1852, with twenty-one members. Marshall P. Wilder, who continued on the Board until his death in 1886 (excepting years 1864–1867 inclusive), was one of the number appointed by the Governor, as was also Prof. Edward Hitchcock of Amherst College. Other men eminent in agriculture were elected members by the societies. One of these original members was James S. Grinnell of Greenfield, who is still an honored member of the Board. Mr. Grinnell and George S. Boutwell of Groton, who was Governor at the time, are the only survivors of the original Board. New societies have been incorporated from time to time, until there are now thirty-eight represented on the Board. The president of the Agricultural College and the chemist to the Board have been made members *ex officio*, so that at present the Board has forty-six members.

Time would fail me were I to attempt to describe the work accomplished by the first secretary, Charles L. Flint, in the twenty-seven years that he served the Board; and that of his successor, John E. Russell, in his seven years of labor for Massachusetts agriculture. Mr. Flint has gone from us, but Mr. Russell is still with us, and often lends a helping voice in the public meetings of the Board and the institutes of the societies.

Among the many valuable services rendered by the Board were its efforts in the campaign against pleuro-pneumonia from 1859 to 1864. It was the influence of the Board upon the Legislature which led to the establishment of the first Board of Cattle Commissioners, and the legislation which continued them in office to look after contagious diseases among domestic animals. It was the Board of Agriculture that petitioned for a law regulating the sale of commercial fertilizers. It followed up the petition by urging upon the Legislature the necessity of the original legislation and all the amendments to the law now on the statute books. The Board was largely instrumental in establishing the Massachusetts Agricultural College. The Board urged State action before the matter was taken up by Congress, and, had it not been for the distractions and expense attending the opening of the civil war, no doubt Massachusetts would have had her Agricultural College before the national grant of lands was made. The Legislature provided that the Board should be overseers of the college, and that duty is now performed by a committee chosen to act for the Board.

It was almost entirely through the efforts of the Board that the State Agricultural Experiment Station was established by the Legislature and equipped with suitable buildings. The establishment of the Gypsy Moth Commission was due to the earnest efforts of the Board of Agriculture, and the duties and responsibilities of that commission have since been put upon a committee of the Board by the Legislature. The Dairy Bureau is also the fruit of earnest effort by members of the Board, in co-operation with the Order of the Patrons of Husbandry. The Bureau is a department of the Board, and under its control.

From time to time the Legislature has directed the Board to make investigations and report upon important subjects, among which are the following: The dangers to human life and health arising from the presence of tuberculosis in the food products of cattle; the "birds of the State, as to their character, habits and value as insect-destroying and grain and fruit destroying birds, and advise as to such legislation as may be necessary;" to collect and circulate information in regard to abandoned or partially abandoned farms, etc.

The care and oversight of the thirty-eight agricultural societies is, however, the especial duty of the Board. The fairs and institutes of these organizations have been attended by delegates or members of the Board appointed for that purpose ever since the Board was instituted.

But all this is history, and, while history is most interesting, the work of to-day is what most intimately concerns us and the agriculturists of the State. The Legislature has for years had great confidence in the Board of Agriculture. This is shown by the liberal appropriations it has from time to time made for agricultural purposes and which are expended by the Board, its secretary and committees. The appropriations for 1892 are as follows: —

Bounties to societies,	$21,500 00
Incidentals for the office of the Board,	500 00
Members' travel,	1,900 00
Secretary's travel,	500 00
Lectures before the Board,	800 00
Dissemination of useful information in agriculture,	1,400 00
Nails for marking shade trees,	100 00
Dairy Bureau,	4,000 00
Balance of appropriation for 1891 for abandoned farms,	1,323 38
Extermination of the gypsy moth,	75,000 00
Total,	$107,023 38

In addition to this large sum, the salaries of the secretary, his clerks and assistant in the work of the Dairy Bureau, amount to $6,800. There is also to be added the expense of printing the report on Agriculture of Massachusetts, $5,897.58, making a grand total of $119,720.96.

The annual report on Agriculture of Massachusetts, eight hundred and forty-four pages, was issued March 24, 1892, of which fifteen thousand copies were printed and distributed to the members of the Legislature (who had as required by law nearly one-half of the edition); to the incorporated agricultural societies, the granges and the farmer's clubs, in proportion to the members of each; to towns that do not have one of these organizations or a member of the Legislature, in proportion to their farming population; and to such individuals as applied for it at the office. A large number are used for exchange with the boards of agriculture and agricultural experiment stations of other States, and sent on application to public libraries in this and other States, and in many instances to foreign countries. The agricultural colleges and experiment stations of almost all the States are prompt applicants for this volume, and the liberal number authorized by the Legislature enables us to supply all demands.

Six monthly crop bulletins have been issued the past season, or one hundred and fifty-six pages in all. These have been mailed to some two thousand farmers of the State, making a total issue of twelve thousand two hundred copies. The information contained has been derived from one hundred and seventy correspondents, residing in all parts of the State. In connection with this work we have during the past season sent out seventeen weekly New England weather-crop bulletins. These weekly reports (thirty-six thousand six hundred) have been furnished by the New England Weather Service in exchange for pecuniary and other assistance we have been able to afford the Weather Service in its work.

We have also, in performance of the duty imposed upon the Board by the Legislature, "to collect and circulate information in regard to abandoned or partially abandoned farms," collected information and obtained descriptions of three hundred and eighty-three such farms, and printed second and third editions of the descriptive catalogue of such property, containing a total of two hundred and twenty-eight pages. Thirty-five hundred copies were printed and distributed. The amount expended for printing circulars, crop reports and catalogues was $917.22. We have expended for postage for correspondence and on circulars, crop reports and catalogues, $405.78. The work of gathering, arranging and editing the material for the crop reports and the two editions of the catalogue of abandoned or partially abandoned farms has been very considerable. The very simple matter of addressing the envelopes for circulars for information, for crop and weather reports and for catalogues sent out, has taken much time. Not less than seventy-five thousand have been addressed during the year.

The correspondence of the office has increased enormously. We have encouraged inquiries from farmers' clubs, granges and individuals about all agricultural matters, and gladly perform the extra work thereby entailed. The provision for nails for marking trees in the highways which the town authorities desire to preserve as shade trees has also made much work in the office. The original act made it the duty of the secretary of the Commonwealth to attend to the matter, but the Legislature of 1891 transferred it to the Board of Agriculture. The nails are procured by the keg, and distributed in packages by express as applied for. We have also made it a practice to notify all parties having bills against the Gypsy Moth Department, the Dairy Bureau and the Board itself when the State Treasurer is ready to pay them. This work properly belongs to other departments; but, as this office is better acquainted with the residence of these parties, we have thought it best to do the work, and thereby save our people possible annoyance.

The expenditure of such large amounts of money upon the approval of the secretary makes it imperative that an itemized account of such expenditures should be kept in the office. Type-written copies of the acts of incorporation and amendments thereto of all the agricultural societies and associations, from 1792 to date, have been prepared, and are kept in the office for reference.

We have commenced the compilation of a synoptical and analytical index of the Massachusetts agricultural reports for the past fifty-two years. This will include Colman's reports, the reports of the secretary of the Commonwealth, and the forty reports of the secretary of the Board of Agriculture. This work when completed will be a great addition to the value of this literature, as the separate volumes have only a general index of subjects. The work is only about one-third accomplished, but it has already taken at least two full months' time of one of the clerks in the office.

The time required to arrange for speakers for the institutes of the societies is considerable. The annual volume, Agriculture of Massachusetts, a book of four hundred pages, exclusive of the report of the State Agricultural Experiment Station, which is bound with it, is prepared for printing and the proof read in this office, requiring many weeks of consecutive labor.

The duties of the secretary as chairman and secretary of the Gypsy Moth Committee take nearly one-fifth of his time. His work as executive officer and secretary of the Dairy Bureau should take as much more; but, on account of lack of time, much that properly belongs to the executive officer has been performed by his assistant, Geo. M. Whitaker.

The secretary of the Board is also *ex officio* a trustee of the Agricultural College and a member of the Board of Control of the State Agricultural Experiment Station, and he serves as secretary of both these organizations, thus bringing together in the office of the Board of Agriculture the records of all the State agricultural organizations except those of the Cattle Commission. The calls on the secretary to attend fairs, institutes and farmers' meetings are numerous and persistent. Few of these invitations can be accepted, on account of the great increase of office work. During the past year the secretary has attended twelve institutes, nine fairs and thirteen other farmers' meetings, and taken part in the literary exercises of each.

The members of the Board have not been dilatory in attending to the duties devolving upon them. The members of the Gypsy Moth Committee have had a meeting on nearly every Tuesday throughout the year, and much time has been spent by the members in overlooking and inspecting the field work. One member of the committee, whose residence is in the infested district, has spent weeks of valuable time in this work, giving to it many hours that he needed for rest and recreation from arduous duties in university and State service on other commissions. The executive committee has had three formal meetings during the year, and in addition the chairman of the committee has been often called upon to consult with and advise the secretary in regard to the work in the office. The examining committee of the Massachusetts Agricultural College has visited the college several times, and was present to examine the senior class at the commencement in June. Other committees have had meetings to attend to the duties assigned them by the Board. The members of the Dairy Bureau meet every month. Members of the Board have attended forty-three institutes, by request of the secretary, in addition to those held by their own societies.

The societies have held one hundred and thirty-three institutes, and speakers have been furnished through this office for seventy-eight of them, at an expense of $662.39. Nearly every member of the Board has attended, as delegate of the Board, one fair other than that held by the society he represents on the Board. All the fairs continue at least two days, so that, adding the time spent in travel to and from, an average of at least three days for each member is occupied by this duty. Two members of the Board of Agriculture serve on the Board of Control of the State Agricultural Experiment Station. This Board holds quarterly meetings, and the members serve without compensation.

One other matter of business should not be passed over. While the Board of Agriculture is not strictly a State department, it is practically such, and the secretary is expected to attend to matters of interest in agriculture and to agriculturists which come before the Legislature, during the five or six months of the annual session. The legislative committee on agriculture continually calls upon the secretary for information and explanations; the Governor and other State officers call on the secretary and clerks for the same purpose; and officers of farmers' organizations and individuals frequently come to the office for information and advice on the bearing of legislation upon their duties and privileges, and for assistance when matters of interest to them are to come before the committees of the Legislature. In addition to all official duty, there are numerous callers to assist and entertain, questions and letters of inquiry to answer, and innumerable other matters that need attention and take time.

This paper has been prepared in order that the agriculturists of the State may learn something of the work of the Board and its employees. The work of the office has wonderfully increased in the past few years. The Legislature has yearly imposed new duties, and the secretary has sought for new avenues of usefulness. Other opportunities are opening before us. The Legislature of 1891 provided another clerk for the office, and the time is not far distant when still another will be needed. The Board has been criticised for inefficiency in some quarters, but it is believed that no body of men in the State, serving without compensation, is more attentive to business or more earnest for the advancement of the interests committed to their charge than the Massachusetts State Board of Agriculture.

The Chairman. Gentlemen, if there are any questions you would like to ask the secretary, he will be very happy to answer them, as he always is, not only here, but at his office.

Gentlemen, we thank you for staying to the end. I shall always remember the pleasant meeting which we have had at Spencer. The meeting is now closed.

REPORT

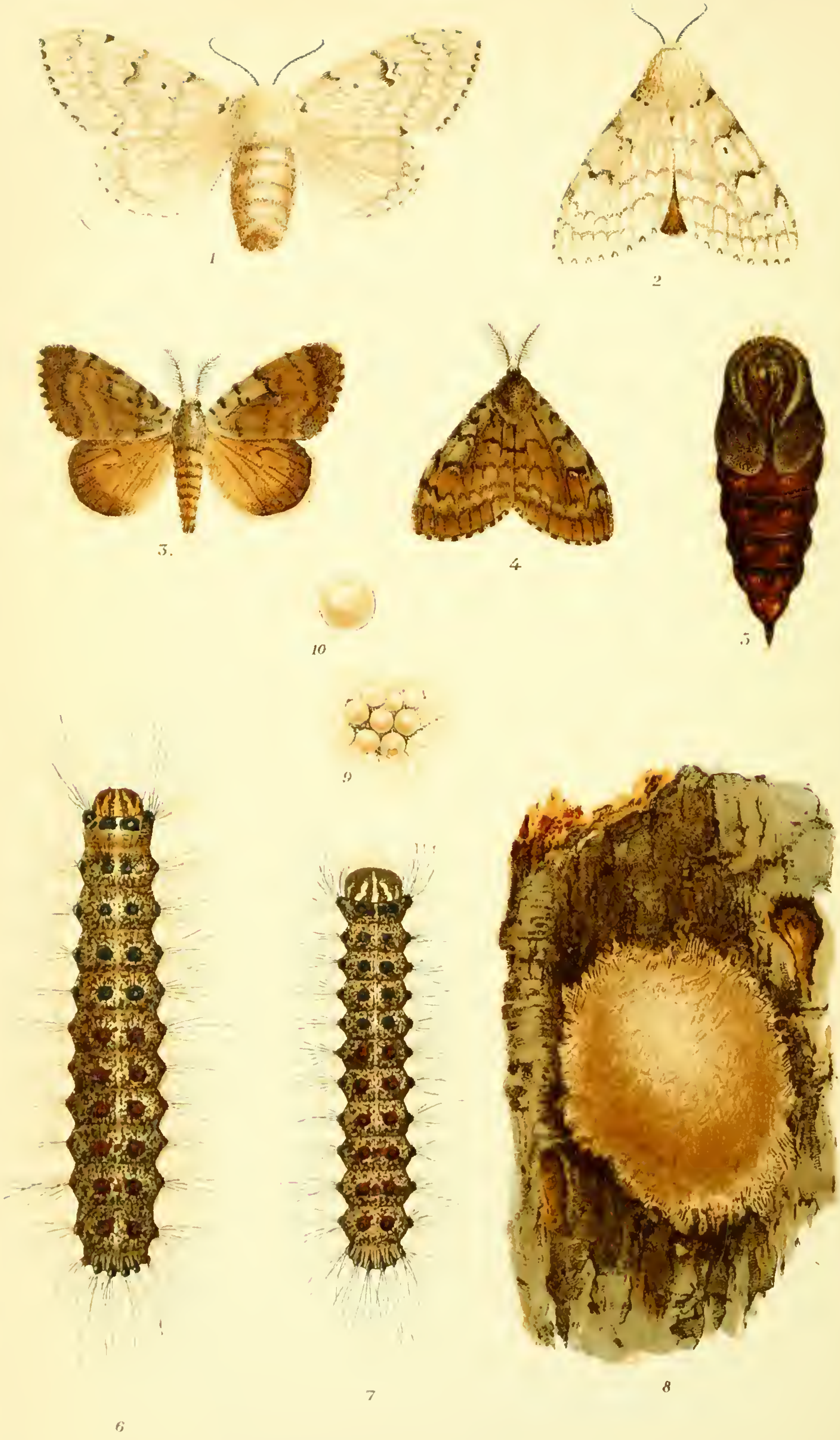
OF THE

STATE BOARD OF AGRICULTURE

ON THE WORK OF

EXTERMINATION OF THE GYPSY MOTH.

PLATE I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Drawn by Joseph Bridgham

Heliotype Printing Co. Boston

GYPSY MOTH

EXPLANATION OF PLATE I.

GYPSY MOTH (Ocneria dispar, L.)

Fig. 1.—Female with the wings spread.
2.—Female with the wings folded.
3.—Male with the wings spread.
4.—Male with the wings folded.
5.—Pupa.
6.—Caterpillar. }
7.—Caterpillar. } Full grown.
8.—Cluster of eggs on bark.
9.—Several eggs enlarged.
10.—One egg greatly enlarged.

THE GYPSY MOTH.

To the Senate and House of Representatives of the Commonwealth of Massachusetts.

In presenting the report of the gypsy moth department of the State Board of Agriculture, in accordance with the provisions of chapter 210, Acts of 1891, the committee desires to call attention to the fact that this effort to exterminate the Ocneria dispar is the first attempt on a large scale ever made in this Commonwealth to destroy a species of insect, consequently there was no trustworthy experience to guide the work. As it was an imported insect, its habits and peculiarities in this country had to be ascertained before the most effective methods of destruction could be determined.

Much of the work that has been done may be considered as in a measure experimental. As we have become more familiar with the extent of the territory invaded by the moth, the magnitude of the task has become more apparent. When the Legislature made the first appropriation, it was supposed that the moth occupied but a small part of one town. Careful inquiry has shown that it infests thirty cities and towns. From our observations we have no doubt that it was in nearly every one of these localities in 1890, when the campaign of extermination was commenced.

The field work during the past year has been in charge of E. H. Forbush, and Prof. C. H. Fernald has been the entomological adviser of the committee.

As experience has been gained, methods of attack have been changed. Comparatively little spraying with Paris green and water has been done the past year. This spraying is effectual in reducing the number of the caterpillars, but will not exterminate them, consequently it has been undertaken only in a few localities, where but little work was done last year.

The destruction of eggs has been found to be an effectual method of eradication. This work must be done in the late summer, fall, winter and early spring. During the caterpillar stage the insect has been extensively trapped by bands of burlap fastened around the infested trees. It has been ascertained that when the caterpillars are nearly full grown they seek shelter during the daytime, and if the holes in the trees are stopped up and the loose bark removed they resort to the burlaps, and can there be easily destroyed. These bands also furnish cover for the caterpillars during their transformation to the pupa stage.

Much effort, involving a large expenditure, has been devoted to the inspection of territory outside the infested limit. Numerous letters have been received from different parts of the State and from adjoining States, to the effect that supposed gypsy moths had been found. These notices have in all cases led to an inspection of the suspected locality. The towns just outside those infested have also received some attention, but in no case has the gypsy moth been found outside of the limits reported last year.

Last year the committee asked for an appropriation of $75,000, believing that sum was as much as could be economically expended, but experience has shown that the appropriation was much too small for the needs. It has been necessary to leave undone much that should have been done. We have been obliged to discharge many faithful, efficient and experienced men, for want of money to pay their wages. We have learned that only such men as are above described are fit for the greater part of the work. There are certain kinds of work which can be performed by ordinary laborers, but to accomplish the most possible, a sufficient appropriation is needed to enable the committee to employ a large force of skilled men continuously throughout the year. At the time the appropriation for 1892 became available, in March last, the force was quite small, having been considerably reduced because of lack of means. Steps were immediately taken to get back the experienced men, but many had obtained permanent employment elsewhere. It was necessary to employ and train new men, and the work for several weeks could not be as effective as it would have been had experienced men been in service. A force of two hundred and thirty men was set at work. These men became more and more valuable as they became acquainted with the territory infested and with the habits of the insect. But again in October we were obliged to discharge all but forty men. Should the committee again undertake to increase the force, they will probably have a similar experience.

We desire to present to the Legislature the state of the problem and various plans for solving it, with an estimate of the cost of each class of work for the next year. There are large areas of woodland in the infested towns. There are points in these forested districts known to be infested. There are probably other points where colonies have been established, and possibly many such. The dense growth of the underbrush in this woodland, and the thick carpet of dead leaves on the ground, make perfect inspection almost impossible. There are about four hundred acres of this woodland which will, if it is allowed to remain, continue to be an uncertain element in our problem.

If the timber could be felled and burned on the ground during the winter and early spring, and the ground carefully burned over twice during the summer, that element would be eliminated. We estimate the cost of this work at $125 per acre, or a total of $50,000; but we are confronted with the fact that most of the forest is situated in Medford, Malden, Arlington, Melrose, Winchester and Stoneham, and that much of it is valued for prospective parks. Its destruction would be considered a calamity by the inhabitants of these places.

We believe that with sufficient means, and in several years' time, these forest lands can be cleared of moths without destroying the timber. To accomplish it all the underbrush and all the decayed and worthless trees must be cut and destroyed by fire, the ground burned over, and the whole carefully inspected at least twice each year. Burlaps must be placed wherever the moth appears or has been found previous to the clearing up. The latter plan will in the aggregate cost more than the former, but, as the work need not necessarily be all done at once, and as it could be done in connection with the other work of the department, utilizing the time of the men in the winter and early spring, it may be the best plan to pursue.

We estimate that there are 1,500 rods of field wall that should be taken down, cleaned of eggs, and rebuilt at a cost of $1.40 per rod, or a total of $2,100. There are also some heavy walls, built of small stones, and some thick bank walls which may be treated by burning all vegetation near them, so as to compel the caterpillars to crawl away from them for food, when they may be caught by burlapping the trees, and thus destroyed.

In any case, enough money should be provided for thoroughly inspecting all the territory of the thirty infested towns and cities, and the towns immediately surrounding those in which the moths have already been discovered. There should also be provided abundant means to burlap all the trees in the thickly infested region, and those in the vicinity of colonies of the moths that have been found in the outer towns that are not so thoroughly infested, and also to employ during the five months of the caterpillar season a sufficient force of men to examine the burlaps and kill the caterpillars once each day. To do this we estimate that at least one hundred experienced men should be permanently employed throughout the year, at an average of $2.35 per day, or a total cost of $72,615. We should also have during the caterpillar season of five months (one hundred and thirty days) at least two hundred and ninety men, at an average of $2.15 per day, or a total cost of $81,055. The bills for supplies, rent and expenses would amount to about $10,000. So by this plan we would need: —

For one hundred experienced men throughout the year,	$72,615 00
For three hundred men for five months,	81,055 00
For taking down, cleaning of eggs and rebuilding walls,	2,100 00
For supplies and other expenses,	10,000 00
Total,	$165,770 00

The committee voted, at a meeting held in December, to ask for an appropriation of $150,000. At that time a careful estimate had not been made, but it is required by law that estimates of needed appropriations be sent to the auditor on or before December 15. From a very thorough consideration of the matter, the above is as small a sum as we can recommend to be appropriated.

The subjoined report of the consulting entomologist and the director of field work will show that the labor of the last year has led to a great reduction in the number of the insects. A fair estimate, based on the number of the species destroyed, indicates that the eggs existing on October 1, as compared with those discovered at that time the previous year, were in proportion of about one to thirty. The records of the work also indicate that three or four hundred colonies of the species which originally existed in various localities have been exterminated, and that the bounds of the region which it occupies apparently have not been extended during the year.

While the committee are convinced that the expenditure during the next year of the large sum which they have suggested is eminently desirable, that it is indeed necessary, to prevent the danger of the spreading of the pest, they are of the opinion that with the amount of money allotted last year it will be possible to still further reduce the numbers of the insects in the densely infested localities, and to eradicate many of the smaller colonies. If this last-named policy is followed, there will, however, be great danger that the insect may extend its hold in the thickly forested parts of the field which it occupies, with the result that it may be much more difficult to secure its extirpation.

Experience having shown that the moth can be eradicated, that it has been destroyed in many limited fields, it now appears advisable to push forward the work of destruction as rapidly as may be found compatible with the careful expenditure of the money, and with the means which the Commonwealth may be willing to devote to the task of protecting its citizens from a grave danger.

As it seems clear that the danger arising from the presence of the gypsy moth in this country is a matter of national importance, the question arises whether this committee may not hereafter seek aid from the Federal government in the prosecution of this work.

The following is the financial report for 1892 of the gypsy moth department, State Board of Agriculture: —

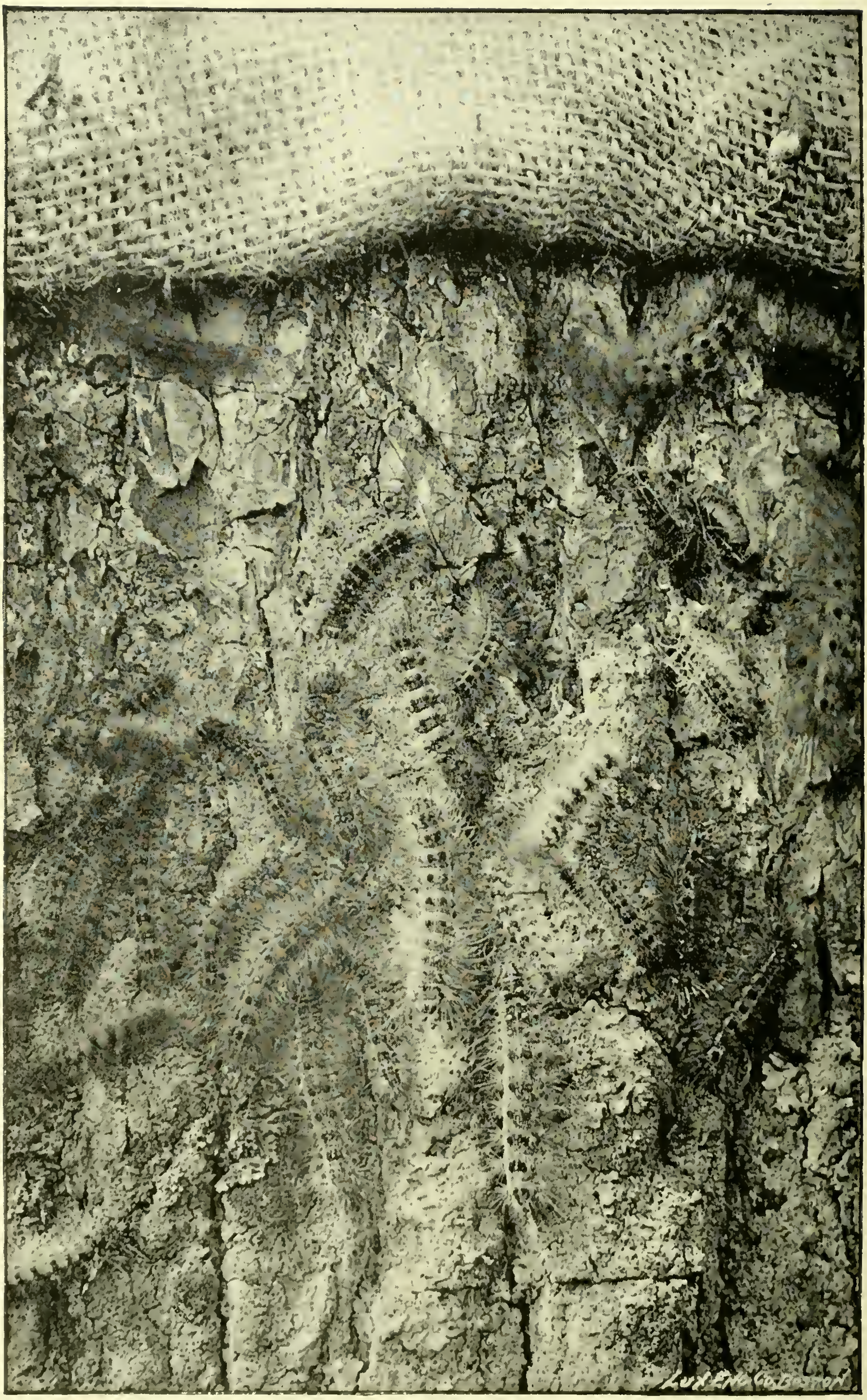
Balance on hand Jan. 1, 1892, ...	$5,213 13
Appropriation, ...	75,000 00
	$80,213 13

Expenditures.

William R. Sessions, expenses,	$21 44
N S. Shaler, expenses,	89 05
Francis H Appleton, expenses,	20 00
C. H. Fernald, entomologist, remuneration and expenses,	525 60
E. H. Forbush, director, salary,	2,400 00
Book-keeper and clerks in office,	2,099 27
Travelling expenses of director and men,	2,188 04
Teaming, livery and board of director's horse,	2,209 25
Wages of men,	57,405 76
Supplies and tools,	7,582 55
Balance on hand Jan. 1, 1893,	5.672 17
	$80,213 13
Total amount expended in 1892,	$74,520 96

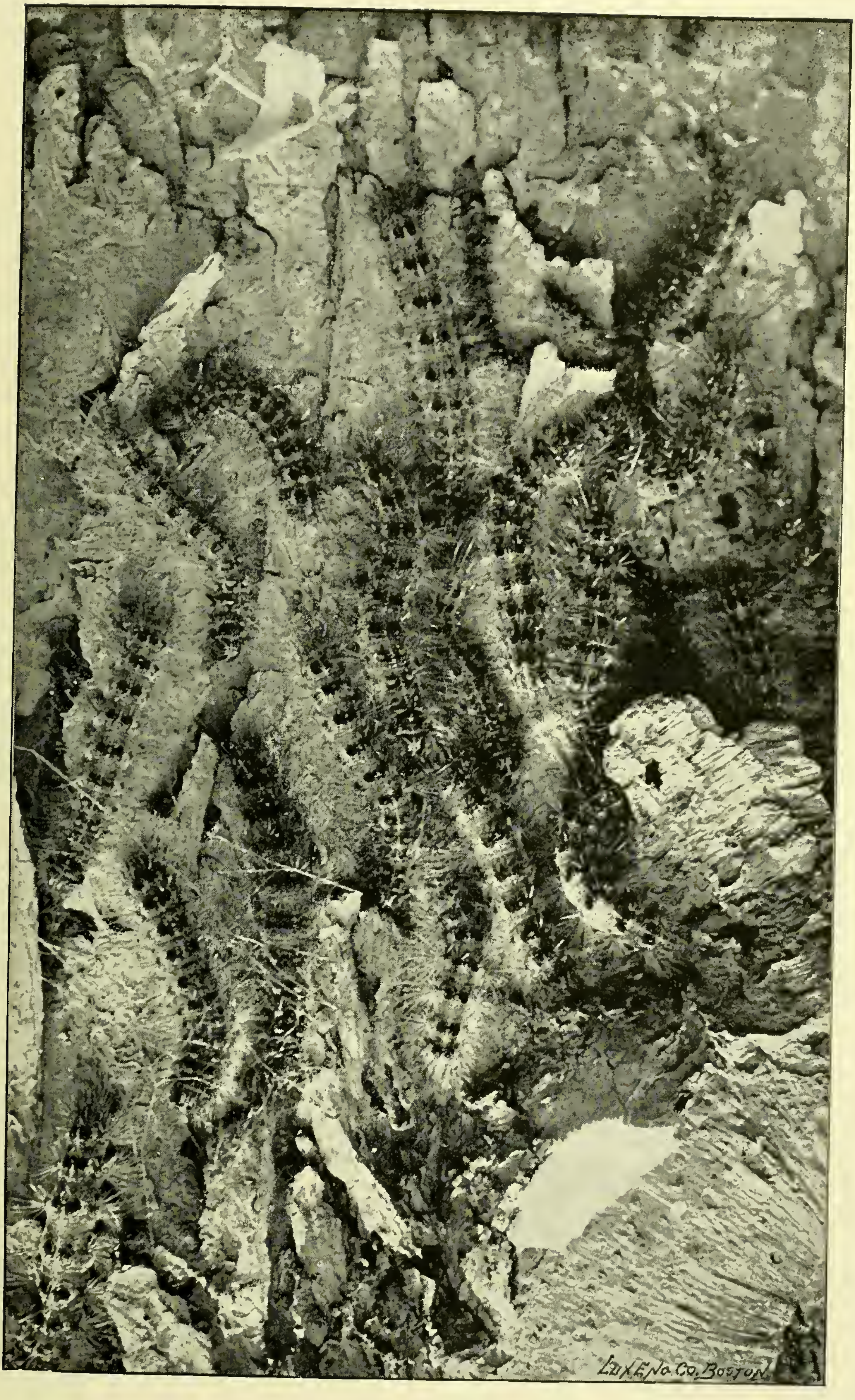
WM. R. SESSIONS,
Secretary of the Board of Agriculture.

JAN. 10, 1893.



Section of burlap band raised, showing gypsy moth caterpillars that had gathered beneath it on the trunk of an elm tree.

From a photograph taken in Malden, Mass., July 9, 1892.


LUXENO CO. BOSTON

Full-grown gypsy moth caterpillars about to pupate on the trunk of a walnut tree.

From a photograph taken in Arlington, Mass., July 9, 1891.

REPORT OF THE DIRECTOR OF FIELD WORK.

To the Committee on the Extermination of the Gypsy Moth.

GENTLEMEN: — In presenting this report, I have, in accordance with your request, included a very brief account of the life-history and habits of the gypsy moth as they have been observed in this country.

The Eggs.

(Plate I, fig. 8, cluster of eggs on bark; figs. 9 and 10, eggs magnified.)

The eggs are deposited in clusters, and covered with yellow hairs from the body of the female moth These egg clusters are usually found in sheltered places on the bark or in the cavities and crevices of trees, stumps and undergrowth, also on fences, buildings, in stone walls, etc., near the plants or trees on which the insect feeds. The eggs are laid in July, August and September, and hatch after the foliage starts in the following spring or in the early summer; therefore the insect passes the fall, winter and early spring in the egg state.

The Larva or Caterpillar.

(Plate I, figs. 6 and 7.)

When first hatched the caterpillars are less than one-fifth of an inch in length. As they grow larger they may be seen upon or in the cavities of the trunks and branches of trees, where they gather in large numbers during June, July and the first part of August.

The Pupa.

(Plate I, fig. 5.)

The caterpillar when full grown sheds its outer covering and becomes a pupa. This usually occurs in July or August. It may be found in the same situations as the eggs. In Massachusetts the insect remains in the pupa state from eight to twelve days.

The Moth.

(Plate I, figs. 1 and 2, female; figs. 3 and 4, male.)

The female usually deposits her eggs very near the abandoned pupa case, and within a few hours after emerging from it. She dies soon after. The male is a rapid flyer. The female does not fly.

Habits of the Caterpillar.

The gypsy moth feeds only when in the larva or caterpillar state. The length of larval life varies somewhat according to circumstances, but probably averages ten weeks. When the caterpillars are first hatched from the eggs they are light in color and covered with whitish hairs. In a few hours they assume a dark hue. They usually remain on or near the egg cluster until they change in color, and, should the weather be cold, they sometimes remain for several days in a semi-torpid condition upon the egg clusters. If the temperature is favorable they will search for food before they are twenty-four hours old. If a green leaf be dropped upon a table on which some of the caterpillars have been placed, they will all move towards it and climb upon it. During the first few weeks of their existence they remain most of the time on the leaves, feeding usually on the under side. Their feeding habits are so uncertain that no rule can be given which will apply to all individuals, but as a rule when about half grown they begin to manifest their gregarious instincts. At that time and for the rest of their existence as caterpillars they spend a large part of the day clustered in sheltered situations, and feed principally at night, going up the trees and out on the branches after dark, and returning before daybreak. Where they are so abundant that the food supply is insufficient, they evince much restlessness, and feed in numbers during all hours of the day and night. They may be seen hastening to and fro, both up and down the trees. Those which have fed sufficiently are at once replaced by hungry newcomers, and the destruction of the foliage goes on incessantly.

At such times the trunks and lower branches of trees are covered with a moving mass of caterpillars. Hurrying throngs are passing and repassing, and nearly every leaf or denuded stem bears up one or more of the feeding insects. The rustling caused by their movements and the continual dropping of excrements is plainly audible. On tall trees the larger caterpillars appear to crawl to the higher limbs, and they seem to prefer to feed well out toward the end of the branches. They do not feed gregariously except when in great numbers; therefore they seldom strip one branch, as do the larvæ of the *Vanessa antiopa*, but scatter throughout the trees, eating a little from each leaf. Early in the season, when they are small and few in number, their ravages are scarcely noticed; but as they grow larger and more numerous their inroads on the tree decrease the foliage area night by night, until suddenly the leaves appear to have been eaten in a single night, and the tree is stripped.

Food Plants.

The gypsy moth is known to destroy the foliage of nearly all native and introduced trees and plants of economic importance. The list of its food plants includes nearly all evergreen and deciduous trees, most bushes, shrubs, vines and vegetables, and when hard pressed it has been seen to eat grass. Wherever the caterpillars become numerous they move slowly, devouring nearly every green leaf and twig as they go. Some of their favorite food plants are the apples, willows, elms, oaks, Norway spruce, rose, strawberry and wistaria. They feed during a much longer season than the canker worm or the tent caterpillar. The eggs of the gypsy moth begin hatching about April 20, and the young continue to emerge until the middle of June. In the months of June, July and August, 1891, trees which had been stripped early in the season and whose leaves had again put out were again defoliated by these caterpillars, and kept bare all summer. Not only was all prospect of a fruit harvest destroyed, but the life of the trees was threatened by such constant defoliation.

History of the Work.

The field work of the season of 1891 consisted largely of organization, experiment, inspection and observation. An attempt was made to define the boundaries of the infested region. The territory was mapped, divided and subdivided; the force of men was mobilized to keep pace as far as possible with the discovery of badly infested localities, and labor was concentrated upon those districts where the moth appeared in greatest numbers. The habits of the moth and those of its parasites and enemies were observed and recorded; its distribution was studied, and a series of experiments with insecticides was conducted. This work, together with that of destroying the several forms of the moth, occupied the entire season, and it was not until January, 1892, that the boundaries of the district occupied by the moth could be even approximately given. The appropriation of 1891 proved insufficient to maintain such a force as was needed to attain the best possible results; therefore, on the first of January, 1892, but forty men were retained in the field. This force was at that time concentrated in the region most densely infested, and was there employed in cutting and burning worthless infested trees and shrubbery, and in destroying eggs by this and other methods until the snow disappeared.

In the spring and fall of 1891 the egg clusters were cut or scraped from the objects to which they were attached, and burned. This method proved to be somewhat ineffective, as eggs were thus occasionally scattered and lost. During the winter of 1891–92 experiments were made to test the effect of cold, rain, snow and ice upon scattered eggs. Twelve thousand eggs were exposed during most of the winter to changes of temperature and to the effects of rain, snow and ice under the most adverse conditions. These eggs were afterwards artificially warmed, and about one-third of them hatched. Under more favorable conditions most eggs when scattered hatched.

Meanwhile, experiments had been made to determine the best and least expensive methods of destroying the eggs without disturbing or removing them. As a result of these experiments, the egg clusters have since been treated with acids. A cheap creosote oil has also proved effective and has been put into general use. Eggs in cavities which could not be reached by the direct application of acids or creosote were destroyed by chlorine, bromine or fire. Thus the danger that had appeared imminent of the eggs being lost during the work of destroying them was reduced to the minimum.

Unfortunately the work of destroying the eggs, which could not be vigorously prosecuted in the fall of 1891 for lack of funds, was delayed in February, 1892, as the appropriation was not immediately available. For this reason the entire force was for some time unemployed. Later the work was much hindered by unseasonable snow-storms. Therefore not as much could be accomplished in early spring as was desirable.

The Work of the Spring and Summer.

As early in March, 1892, as an appropriation was available, trustworthy men who had been employed the previous season were at once engaged, and the force was increased as fast as other competent men could be found. The utmost care was exercised in selecting them. Each candidate was examined and required to give satisfactory references as to character and ability. Only a small proportion of the applicants proved sufficiently keen-sighted, and many of those whose eyes passed the test were otherwise deficient. As a result of these examinations, a better class of men was employed than the average of those engaged in 1891.

Owing to a lack of full and explicit information in regard to the size of the area infested in 1891, no very definite plan could then be carried out during the year. In January, 1892, it was known that thirty townships were infested, and also about what proportion of the work each town would probably need. Such experienced men were chosen as inspectors as were fitted for the position, and each was given his quota of men as they were engaged.

An inspector was assigned to each town in the region least infested. Those towns most seriously infested were divided into sections, and an inspector and men were assigned to each section. It was proposed to keep each inspector in the locality to which he had been assigned, that he might by experience become intimately familiar with his territory, and the distribution and habits of the insects there, for we were convinced that this was the only plan by which extermination could be ultimately effected. In this way we were enabled to determine the number of men that would be required to destroy the eggs over the entire area in a given time. The egg killing was pushed during the months of March and April. The inspection was not in all cases thorough, as a large proportion of the force engaged in it was necessarily composed of inexperienced persons, and there were not enough expert men to reinspect their work. Thus we were unable in the spring of 1892 to do thoroughly the work which might have been done in the fall of 1891 had sufficient money remained. We were also unable to secure and train men enough, in the short time at our disposal in the spring, to cover the entire field. Thus, as in the previous season, there remained at hatching time a considerable area in which the eggs had not been destroyed.

Special efforts were made in all infested towns to destroy the eggs on trees along the highways. In the worst infested district these trees were then banded in such a way as to prevent the caterpillars from ascending them. The German insect lime which was recommended to the committee by Dr. Riley and Professor Fernow, both of the United States Department of Agriculture, was used experimentally in 1891. Early in 1892 four tons of this material were imported. This lime was used in banding street, orchard and forest trees. It was placed on trees side by side with several other mixtures from American manufacturers, and was found superior to them all. Not enough, however, had been imported to protect all the trees, and in Medford and Malden many were banded by the method pursued last year. This was quite as effective as the insect lime in stopping the caterpillars, but was more costly, as frequent applications were required, while the insect lime, when once properly applied, remained in good condition for nearly two months and needed very little attention. As a result of this method of banding trees along the highways, the caterpillars were kept out of such trees and there was no danger of their falling upon people, animals or moving vehicles, and being distributed by such means. For this reason trees near houses, stables and other buildings were also banded with insect lime. Trees near fences, stone walls and other objects in or under which the creatures hide and deposit their eggs were also banded It was seen by inspection that where this was done the caterpillars, which were thus prevented from ascending trees, crawled to others which were not banded. As these trees were at a distance from fences and buildings, the moths did not return to their former hiding places, but passed through their transformations and laid their eggs on or near the unbanded trees, where they were easily found and destroyed. The advantages gained by this method are obvious.

Two spraying teams were used in 1892, in place of thirty teams used in 1891, and these but for a short time. These teams were sent from place to place to spray the trees wherever the caterpillars appeared in numbers, and thereby diminish the number and lessen the danger of dissemination.

When the eggs had hatched it was seen that the caterpillars were sparsely distributed in the worst infested territory, and that there were few where last year there had been many. In the peripheral districts there were many formerly infested localities where none appeared, and very few were found in most towns that were near the border of the infested region.

The habits of the caterpillar are such that the method of banding the trees with burlap appears the most effective one yet devised to dispose of this form of the moth. The burlap offers them a convenient shelter, and if it is put on all infested trees, and frequently examined, many caterpillars will be caught that would otherwise escape notice. One hundred and fifty thousand yards of this material were purchased. It was cut into strips and applied to the trees in infested localities. It is necessary to examine the burlap bands once each day, or at least once in two days, to be sure of securing all the caterpillars which gather beneath them. The number of men employed at that time was not sufficient to properly inspect the bands, and, owing to the limited amount of money at our disposal at that time, we were unable to employ more men. Notwithstanding this disadvantage, burlapping and hand-killing disposed of nine-tenths of the gypsy moths in the infested region during the summer, and in many localities they were exterminated by this work alone.

The Fall Inspection.

The time when the eggs of the gypsy moth can be destroyed with the utmost certainty of extermination is in the late summer and early fall, as soon as possible after they are deposited. If they are not disposed of at this time, some of the egg clusters may be broken and the eggs scattered by men, animals or the elements. When thus scattered they are likely to be overlooked by the searchers, and left to hatch. The eggs were destroyed in connection with the burlapping in the late summer and early fall; but in September it was found necessary to again reduce the force, as the money on hand at that time was not sufficient to maintain it longer. About forty men were retained. With this small number of men little could be done toward a thorough inspection of the worst infested towns, and these were left until some future time. Therefore, no systematic egg destruction was attempted in Malden, Medford, Arlington, Melrose, Everett and Chelsea in the months of October, November and December. In October an inspection of those infested towns which lie farthest from the infested centre was begun. Men whose experience had fitted them for the work in these towns were retained. This inspection has now been nearly completed in Wakefield, Lynnfield, Reading, Beverly, Watertown, Brighton and Woburn. Considerable work has also been done in Somerville and Cambridge, and much more should be done in the spring, as these cities are centres from which the moths may be distributed to towns south and west of Boston.

Present Condition of the Infested Region.

At this time (Jan. 1, 1893) Lynnfield, Reading and Watertown, which have been carefully inspected, have not yet been reinspected. No moths have been found in Reading since the eggs were first discovered and destroyed there in December, 1891. The only evidences of the creatures that were found there during the past fall were three isolated, decaying pupæ, which probably were overlooked in the inspection of December, 1891 There is now but a small portion of the town which has not been examined. Several of the colonies found in Lynnfield were probably exterminated in December, 1891, or during the past summer, but a few colonies were found during the fall after the eggs had been laid. These had evidently been overlooked in 1891. All seem now to have been exterminated. The condition is apparently the same in Watertown, but both of these towns will probably need thorough reinspection for several seasons. No living form of the gypsy moth has been found in Waltham since December, 1891, when they were first discovered there; but as a thorough systematic search of the town has not been made since that time, it is possible that there are a few small colonies scattered through it, and it should be thoroughly inspected before the eggs hatch in the spring. All forms of the moth that have been found in Beverly, Lexington and Brighton have been destroyed, but these towns ought to be thoroughly reinspected and carefully watched for at least two or three seasons.

The eggs found in the infested localities in Marblehead in November, 1891, were destroyed at that time, and nothing has been found since in these localities; but during the fall inspection eggs and other evidences of the moth were found at a distance from those formerly infested localities. In these places they had evidently been established for some two seasons, and were overlooked during the fall of 1891. The inspection of Marblehead has not yet been completed.

In Woburn local extermination has cleared most of the localities which were known in 1891 of all forms of the moth. Several colonies have been found during the fall. The same may be said of Wakefield.

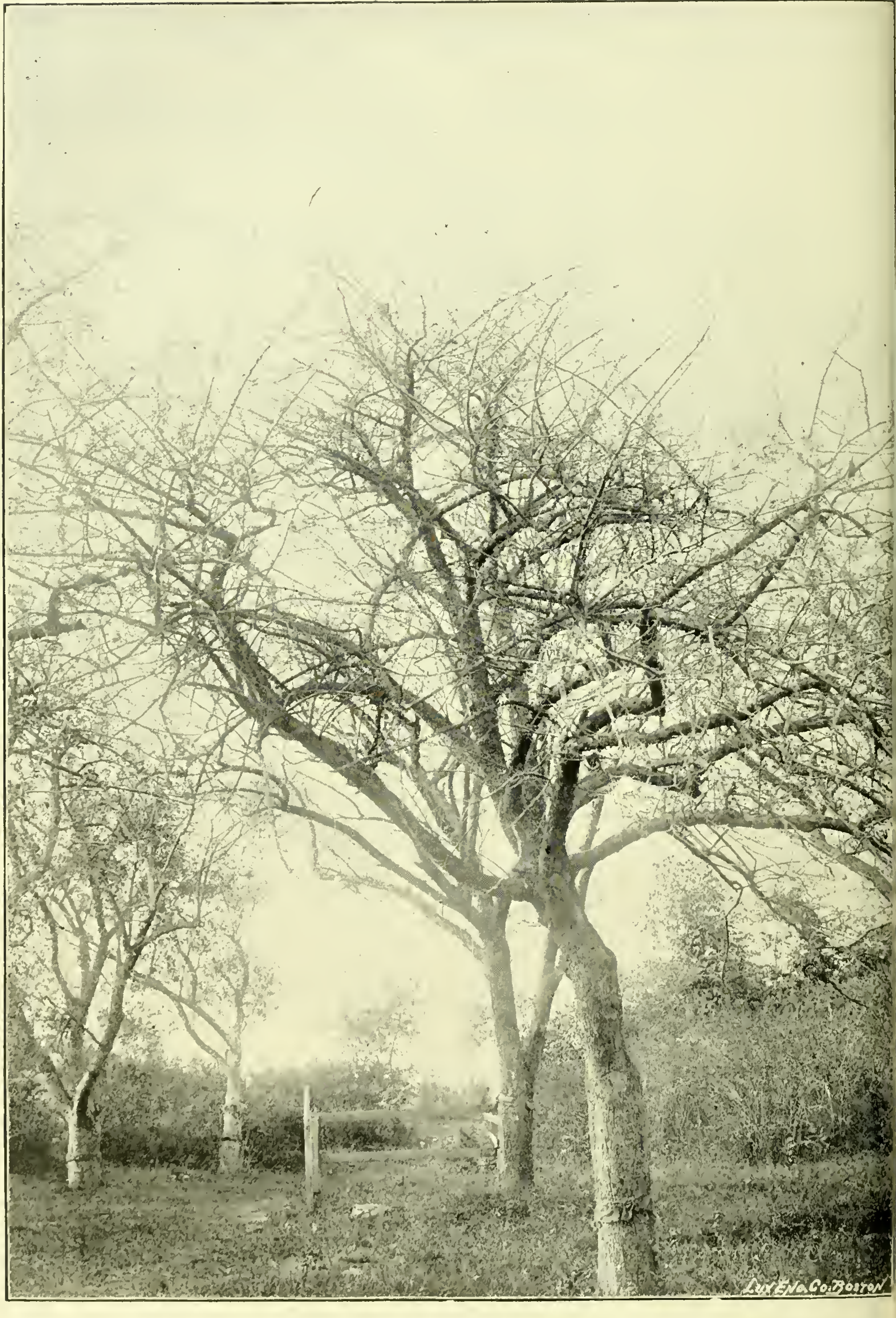
Many of the colonies formerly known in Arlington, Cambridge, Winchester, Stoneham, Melrose, Lynn, Peabody, Salem, Swampscott, Revere and Chelsea have been destroyed. A few colonies have been exterminated in Somerville, Saugus, Winthrop and East Boston. The number of moths in the towns most infested, such as Medford and Malden, has been reduced about ninety per cent. in the past year. In the winter of 1891-92 fifty men were employed in these towns in destroying eggs, and, although the eggs had been numerous there, a greater part of the area covered by these towns was well cleared during the winter. Could one hundred expert men have been employed the past fall, the work in some portions of these towns might have been carried to the point of extermination. Although such a reduction in numbers has been made, it is quite probable that, if no eggs are destroyed in these towns during the winter, the insects will appear in some portions of them in the spring in about the same numbers as in the spring of 1892.

Everett, Somerville, Chelsea, Winthrop, Saugus and Belmont are infested in about the order named, and all need immediate attention.

During the past summer probably less than twenty trees in Massachusetts have been injured to a perceptible degree by the gypsy moth. Although in a few instances many thousand caterpillars were discovered, they were killed in time to save the vegetation in the vicinity. It will be noticed that several small colonies were found during the fall inspection of 1892 which were overlooked during that of December, 1891. The latter inspection was undertaken with a view of determining what towns were infested, that the Legislature might be informed as to their number and condition. This inspection was somewhat hurried, owing to the limited time at our disposal before January 1. When one town was found considerably infested the inspectors went on to the next, leaving the work of a more thorough examination to be done in 1892.

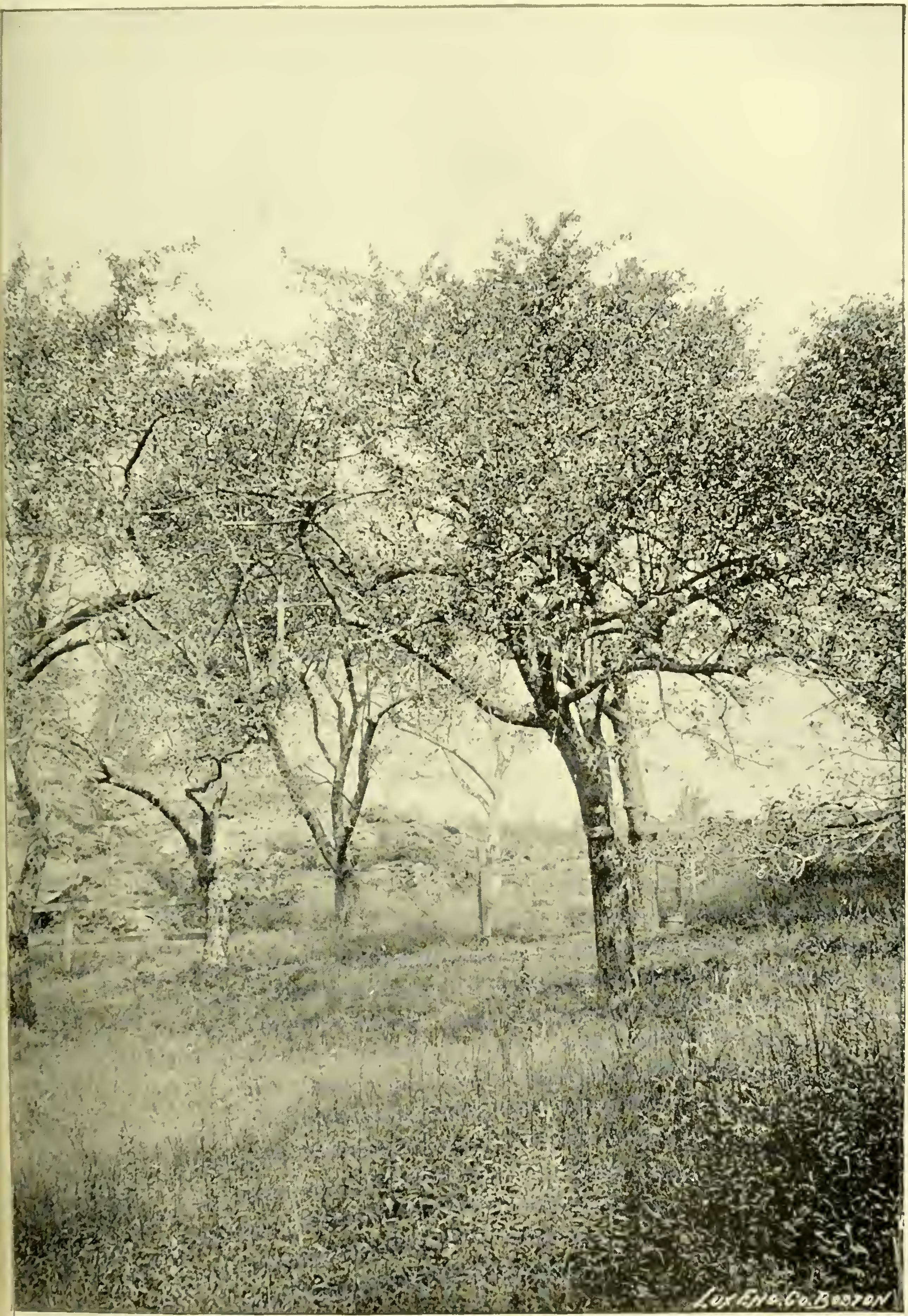
Progress toward Extermination.

While this insect is certainly one which is difficult to exterminate, it seems, in the light of our present knowledge, that it can certainly be


LUX ENG. CO. BOSTON

Apple orchard stripped by caterpillars of the gypsy moth, Swampscott, Mass.

From a photograph taken Aug. 5, 1891.


LUX ENG. CO. BOSTON

View of the same orchard in Swampscott, Mass., showing the results of the work.

From a photograph taken in July, 1892.

held in check and prevented from further spreading. It is also comparatively easy to reduce the numbers found in any badly infested locality. From the daily reports which are made by inspectors, records are kept in the office of the numbers of each form of the moth that are found in each infested place. During the spring and summer of 1891, the eggs, caterpillars and pupæ were gathered by quarts in every badly infested locality, and the number was thus estimated. Since that time all egg clusters and other forms of the insect have been counted as they were killed, and the records kept of these figures show the condition of each infested locality to-day as compared with its condition when first found. In the vicinity of Muller Brothers' Tannery, in North Cambridge, some thirty thousand egg clusters were burned in the spring of 1891. In the spring of 1892 twenty-five egg clusters were found in the same locality, and during the fall inspection of that year only one was found there. At H. W. Spurr's estate in Arlington, a small grove of trees was entirely stripped of its leaves by the caterpillars in 1891, and baskets full of the pupæ were destroyed there. At that time one man gathered and counted over eleven hundred pupæ in one hour, and the moths were so numerous that no count of them or their egg clusters was attempted; the ground was afterwards cleared by fire. In the spring of 1892 four hundred and forty-nine egg clusters were found there, and in the fall inspection only sixteen were discovered. Near McGowan's Tannery, in Medford, several large oak trees were badly infested. They had been entirely stripped of their leaves in 1890, and in 1891 the caterpillars crawled out from between the walls of the tannery (where the moths had laid their eggs the previous fall) and were destroyed by the pailful. In the spring of 1892 five hundred and nine egg clusters were found there, and during the autumn only three have been taken. On the south and west sides of a hill on Humphrey Street, Swampscott, the caterpillars of the gypsy moth destroyed nearly all vegetation in July and August, 1891, in spite of all that was done to check them. Many of the trees were afterwards cut and the ground was burned over. Much spraying was also done with Paris green, yet in the spring of 1892 two thousand six hundred and thirty-eight egg clusters were gathered there, and the larvæ hatched in swarms from eggs which were hidden under the rocks and buildings. The ground and shrubbery was burned over again, and a hurried search this fall has thus far revealed only one egg cluster. Many other instances might be given where the work has been equally effective. It is thus shown that it is possible to so diminish the numbers in badly infested localities that their condition will be essentially the same as that of such colonies as have already been exterminated.

The moth has been exterminated in three hundred and ninety localities. Two hundred and sixty-one of these were found and the eggs destroyed in 1891 or in the early spring of 1892, and they have been carefully watched the present season. In most of these cases no form of the gypsy moth appeared in these localities during the summer, fall or winter of 1891, and none have appeared since. The moth has been exterminated in one hundred and twenty-nine localities by burlapping and hand-killing during the summer. These were all well marked and isolated colonies of the moth. They were all so far from other infested places that their entire extermination seems certain. There are also hundreds of estates which have been cleared of all forms of the moth, but they are so close to other infested grounds that they are not included in this list. There are also many localities where isolated colonies have probably been exterminated during the past summer, but the surroundings are of such a nature that we do not yet feel certain that this is the case. If nothing should appear in these places or in their vicinity by the first of September, 1893, they may then be added to the list.

During the fall inspection thirty-eight small and isolated colonies have been found in the border towns. These, with one exception, must have been overlooked in the hurried inspection of December, 1891. The exception was an apparently new colony, consisting of two egg clusters, which were found on an apple tree under which two doctors and a pedler were accustomed to allow their teams to stand during the summer while visiting houses near by. Most of these thirty-eight colonies are probably exterminated at this time.

The experience of two seasons has thus proved that it is possible to exterminate the moths locally, and that, while it is almost impossible to destroy them all in one season where they are very numerous, it is quite possible, where they are few, to destroy them all in that time.

The Magnitude of the Undertaking has not been Generally Appreciated.

From the time of the identification of the first specimen of the gypsy moth in Massachusetts until the present time, the extent of its dissemination and the effort and expense necessary to control and destroy it have been underestimated. It was thought in the spring of 1890 that it was confined to Malden and Medford, although Professor Fernald thought it quite probable that it had spread over a larger area, as the following quotation from the "Special Bulletin of the Hatch Experiment Station of the Massachusetts Agricultural College of November, 1889," will show: —

"In this country it occurs only in Medford, Mass., and, so far as I could learn at the time of my first visit to that place, it occupied an area in the form of an ellipse, about a mile and a half long by half a mile wide. This represents the territory where the outbreak occurred and where the insects were very abundant; but without doubt they are distributed in smaller quantities outside of this ellipse, but how far it is now impossible to tell."

At that time (1890) fifty thousand dollars were appropriated by the Legislature to exterminate the gypsy moth in those few towns. At the end of the year it was known to be in at least eight towns, but only fifty thousand dollars more were appropriated for 1891. During 1891 it was found in thirty townships, and this was to have been expected in view of the fact that it had been allowed to spread for twenty years, entirely unmolested by man. Yet but seventy-five thousand dollars were asked for to continue the work over this area of two hundred square miles for twelve months. This amount was appropriated by the Legislature. It is needless to say that this sum proved insufficient to do all that could have been done to good advantage in a season's work over such an area.

Had the Board been aware at the outset that the moth was distributed over thirty townships, it is doubtful if anyone would have had the courage to advocate or undertake its extermination. The area of the region over which it is distributed, however, is one of the least of the difficulties in the way of its extermination, and these difficulties can only be fully appreciated by those actually engaged in the work.

The following summary is given to show the magnitude of the undertaking, and such results of the work as can be accurately tabulated: —

Number of Men employed Each Week.

Week Commencing	Week Ending	No. of Men.
Jan. 4, ...	Jan. 9, ...	46
11, ...	16, ...	46
18, ...	23, ...	47
25, ...	30, ...	48
Feb. 1, ...	Feb. 6, ...	48
8, ...	13, ...	48
15, ...	20, ...	31
22, ...	27, ...	68
29, ...	March 5, ...	88
March 7, ...	12, ...	111
14, ...	19, ...	127
21, ...	26, ...	141
28, ...	April 2, ...	191

Number of Men employed Each Week — Concluded.

Week Commencing	Week Ending	No. of Men.
April 4,	April 9,	219
11,	16,	234
18,	23,	233
25,	30,	230
May 2,	May 7,	232
9,	14,	183
16,	21,	140
23,	28,	140
30,	June 4,	91
June 6,	11,	90
13,	18,	87
20,	25,	89
27,	July 2,	93
July 4,	9,	95
11,	16,	102
18,	23,	120
25,	30,	120
Aug. 1,	Aug. 6,	126
8,	13,	129
15,	20,	122
22,	27,	107
29,	Sept. 3,	107
Sept. 5,	10,	97
12,	17,	95
19,	24,	37
26,	30,	33
Oct. 3,	Oct. 8,	38
10,	15,	36
17,	22,	37
24,	29,	37
31,	Nov. 5,	38
Nov. 7,	12,	38
14,	19,	37
21,	26,	34
28,	Dec. 3,	36
Dec. 5,	10,	36
12,	17,	35
19,	24,	34
26,	31,	33

Work Done.

Trees.

Fruit, shade and forest trees:

Inspected,	2,109,852
Found to be infested,	108,428
Cleared of eggs,	99,989
Cemented,	12,172
Banded (tarred paper),	14,013
Banded (insect lime),	21,251

Burlapped,	110,108
Sprayed,	7,372
Fruit and shade trees cut,	395
Acres of brushland and woodland cut and burned over,	115

Buildings.

Inspected,	22,102
Found to be infested,	1,557
Cleared of eggs,	1,427

Wooden Fences.

Inspected,	24,936
Found to be infested,	2,365
Cleared of eggs,	2,159

Stone Walls.

Inspected,	2,213
Found to be infested,	672
Taken down, cleared of eggs and relaid,	354

Number of each form of the moth destroyed during the year by hand:

Caterpillars,	935,656
Pupæ,	80,021
Moths,	9,338
Hatched or infertile egg clusters,	40,954
Unhatched and probably fertile egg clusters,	99,790

It will be noticed that the number of trees inspected during the season is much less than the number inspected in 1891. For this there are two reasons: 1. Some twenty towns were inspected in 1891 along the border lines, and outside of the known infested region In 1892 these towns received very little attention; 2. More time and care has been devoted to inspecting and cleaning the trees this year, and to the inspection of the burlap.

The comparison of the number of trees, buildings and fences found infested this season with the number found infested last season indicates a great improvement in the condition of the region.

A Comparison of the Number of Men employed, Number of Towns Worked in, and Number of Egg Clusters found between Similar Dates in the Past Seasons.

From April 5, 1891, to May 16, 1891.

Number of egg clusters found,	757,760
Average number of men per week,	159
Average number egg clusters per man,	4,765

Towns Worked in.

Arlington,
Belmont,
Cambridge,
Chelsea,
Everett,
Lexington,
Lynn,
Malden,
Melrose,
Medford,
Revere,
Somerville,
Saugus,
Stoneham,
Wakefield,
Winchester,
Woburn. — 17.

From April 4, 1892, to May 14, 1892.

Number of egg clusters found,	38,760
Average number of men per week,	222
Average number egg clusters per man,	175

Towns Worked in.

Arlington,
Belmont,
Beverly,
Chelsea,
Cambridge,
East Boston,
Everett,
Lynnfield,
Lexington,
Lynn,
Malden,
Melrose,
Medford,
Peabody,
Revere,
Somerville,
Salem,
Saugus,
Swampscott,
Stoneham,
Watertown,
Winthrop,
Winchester,
Woburn,
Wakefield. — 25.

From Oct. 1, 1891, to Jan. 1, 1892.

Number of egg clusters found,	21,632
Average number of men per week,	48
Average number egg clusters per man,	450

Towns Worked in.

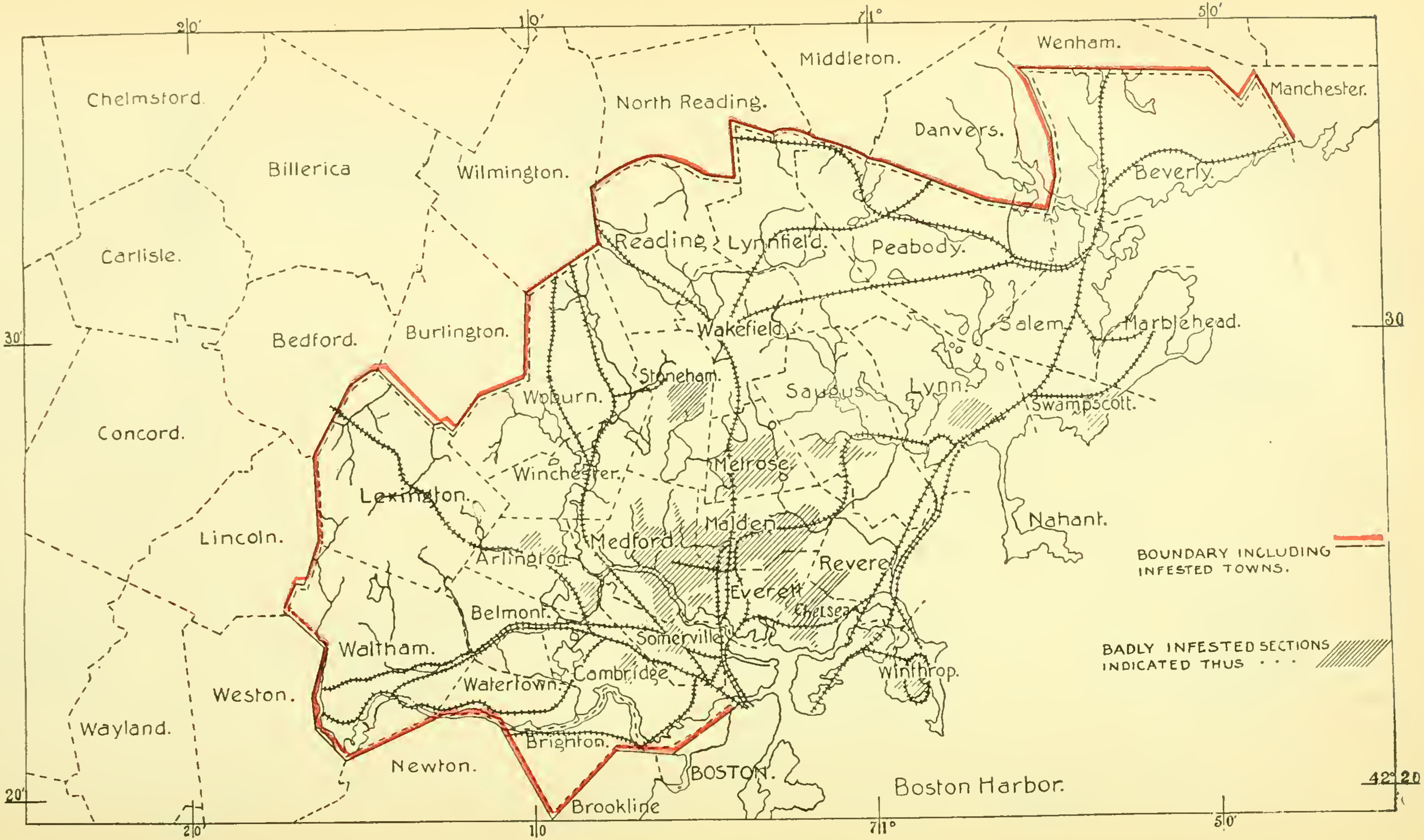
Arlington,
Belmont,
Beverly,
Brighton,
Cambridge,
Chelsea,
Everett,
Lynn,
Malden,
Medford,
Marblehead,
Melrose,
Peabody,
Reading,
Salem,
Somerville,
Stoneham,
Wakefield,
Watertown,
Winchester,
Woburn. — 21.

From Oct. 1, 1892, to Jan. 1, 1893.

Number of egg clusters found,	3,407
Average number of men per week,	36
Average number egg clusters per man,	84

Towns Worked in.

Arlington,
Belmont,
Beverly,
Brighton,
Cambridge,
Chelsea,
East Boston,
Everett,
Lexington,
Lynn,
Lynnfield,
Malden,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Chelmsford.
Billerica
Wilmington.
North Reading.
Middleton.
Wenham.
Manchester.
Danvers.
Beverly.
Carlisle.
Reading.
Lynnfield.
Peabody.
Bedford.
Burlington.
Wakefield.
Salem.
Marblehead.
Stoneham.
Woburn.
Saugus.
Lynn.
Swampscott.
Concord.
Winchester.
Melrose.
Lexington.
Nahant.
Malden.
Lincoln.
Medford.
Arlington.
Revere.
Everett.
Chelsea.
Belmont.
Somerville.
Waltham.
Winthrop.
Watertown.
Cambridge.
Weston.
Wayland.
Brighton.
Newton.
BOSTON.
Boston Harbor.
Brookline
BOUNDARY INCLUDING INFESTED TOWNS.
BADLY INFESTED SECTIONS INDICATED THUS . . .

MAP OF THE REGION FOUND INFESTED IN 1891.

This area contains about 200 sq. miles.

Marblehead,
Medford,
Melrose,
Revere,
Peabody,
Salem,
Saugus,
Somerville,
Stoneham,
Wakefield,
Watertown,
Winchester,
Winthrop,
Woburn. — 26.

A Complete List of the Infested Places.

Arlington,
Belmont,
Beverly,
Brighton,
Cambridge,
Charlestown,
Chelsea,
East Boston,
Everett,
Lexington,
Lynn,
Lynnfield,
Malden,
Marblehead,
Medford,
Melrose,
Peabody,
Reading,
Revere,
Salem,
Swampscott,
Saugus,
Somerville,
Stoneham,
Waltham,
Wakefield,
Watertown,
Winchester,
Winthrop,
Woburn. — 30.

False Alarms.

Numerous complaints have been received from many towns and cities, both in Massachusetts and adjacent States, to the effect that the gypsy moth has appeared within their borders in abundance. In many cases needless alarm has been created by the publication in the daily press of statements which have been afterwards disproved. We have at times had good reason to believe that the gypsy moth had been found in some cases, but in no case has it yet been found outside the district known to be infested in 1891.

Following is a list of places from which reports have come, or which have been visited in following clues. No evidence of the presence of the gypsy moth has been found in any of these places: —

Places that have been falsely reported as infested by the Gypsy Moth.

Massachusetts.

Acton,
Ashburnham,
Athol,
Bedford,
Billerica,
Boston (Common),
Boxford,
Braintree,
Brockton,
Brookline,
Chicopee,
Clinton,
Concord,
Danvers,
Dorchester,
Essex,
Georgetown,
Globe Village,
Gloucester,
Hamilton,
Haverhill,
Holden,
Hopedale,
Hull,
Ipswich,
Kendall Green,
Lancaster,
Lawrence,
Leicester,
Lincoln,
Lowell,
Manchester,
Milford,
Mitteneague,
Nahant,
Newburyport,
Newton,
North Reading,
Pittsfield,

Plymouth,
South Lincoln,
Spencer,
Springfield,
Uxbridge,
Wayland,
Wenham,
Westfield,
Weston,
Whitinsville,
Wilkinsonville,
Wilmington,
Worcester.

Other Places where Suspected Localities have been inspected in which no Moths have been found.

New Hampshire.

Barnstead,
Centre Harbor,
Conway Junction,
Great Falls,
Hayes,
Manchester,
Milton,
Rochester,
Salmon Falls,
Union,
Wolfborough Junction

Maine.

Georgetown,
Livermore Falls,
South Berwick.

Circumstances Favorable to the Extermination of the Gypsy Moth, not given in the Report of 1891.

1. An increased number of its enemies has been observed. Five species of beetles and many spiders have been seen to eat the caterpillars. The following birds have been seen to feed upon the moths, caterpillars or eggs: —

Phœbe,	*Sayornis phœbe.*
American robin,	*Merula migratoria.*
Catbird,	*Galeoscoptes carolinensis.*
Brown thrasher,	*Harporhynchus rufus.*
Bluebird,	*Sialia sialis.*
Chickadee,	*Parus atricapillus.*
American redstart,	*Setophaga ruticilla.*
Black and white warbler,	*Mniotilta varia.*
Maryland yellow-throated warbler,	*Geothlypis trichas.*
Yellow warbler,	*Dendroica æstiva.*
Red-eyed vireo,	*Vireo olivaceus.*
White-eyed vireo,	*Vireo noveboracensis.*
Yellow-throated vireo,	*Vireo flavifrons.*
Chipping sparrow,	*Spizella socialis.*
English sparrow,	*Passer domesticus.*
Yellow-billed cuckoo,	*Coccyzus americanus.*
Black-billed cuckoo,	*Coccyzus erythrophthalmus.*
Blue jay,	*Cyanocitta cristata.*
Baltimore oriole,	*Icterus galbula.*
Purple grackle or crow blackbird,	*Quiscalus quiscula.*
Kingbird,	*Tyrannus tyrannus.*
Wood pewee,	*Contopus virens.*
White-bellied nuthatch,	*Sitta carolinensis.*
Oven-bird,	*Seiurus aurocapillus.*

2. Many parasites have been found upon them. These are given in detail in the report of the entomologist which follows this report.

3. A scarcity of male moths found, as compared with the number of females, has been observed this year in the region which was badly infested last year, and where the agents of the Board have done the most work.

4. The number of egg clusters in the infested region has been reduced at least ninety-nine per cent. in less than two years' time, and in over three hundred localities the moths have been exterminated.

Why More Money is needed.

The question which at once occurs is this: If so much has been accomplished by local extermination with the means provided, why ask for a larger sum to continue this work? This question is easily answered, if we remember that the growth and spread of an insect pest is analogous to that of a conflagration, and that it is safer and less expensive in the end to concentrate all the force possible upon it, that it may be subdued at once. When that is done, the only safe plan is to keep a large force of watchmen ready to find, attack and extinguish the fire wherever smouldering embers break out into flame, and to watch for all sparks in the neighborhood and extinguish them. In this case wherever fertile eggs are left there is always danger of another outbreak. In the past we have been obliged by lack of means to neglect a large part of the region at certain seasons of the year, and much work has been left unfinished as other work became more pressing; therefore the moth has been allowed to increase in some localities where it should have been held in check, and it has been allowed to remain in others where it might have been exterminated.

Plans for Future Work.

There is but one plan which promises extermination, and that is to keep the whole region under constant inspection and to make occasional inspections of the towns in its vicinity. To accomplish this we require: —

1. An adequate number of trustworthy, intelligent, persevering and industrious men, with good eyesight and otherwise fitted by nature for the work. It will take at least a year's time to secure such a force of men, and to so instruct and train them as to bring them to a state of the highest efficiency.

2. For a time a large force of inexperienced men can be employed to advantage in putting on insect lime, burlapping, cementing cavities in trees, and cutting and burning underbrush.

3. The present small force of expert men, and such others as can

be engaged, will be needed to reinspect the work of the new force, as it is never well to incur any risk which may arise from the carelessness of any one man.

4. A sufficient number of superintendents or foremen must be employed, to keep the entire force under constant supervision.

Each inspector must be assigned to a section of such size as he can inspect as often as is necessary; he must be kept there until he knows the section thoroughly and becomes intimately acquainted with the habits and preferences of the moths in that section. When he has acquired this knowledge, he must be given as many men as he needs to destroy all the moths there at the earliest possible moment, and his work must be reinspected by others, as before mentioned One experienced, trustworthy, able-bodied, expert man will do more under proper supervision toward securing extermination than ten or even twenty inexperienced or untrustworthy men. If in 1893 the committee be provided with the means to secure such a force, and in 1894 with the means to continue it, more can be done toward extermination than could have been accomplished with a thousand inexperienced men in 1892. The towns on the border of the infested region ought in 1893 to be cleared of the moths, and they will probably be exceedingly rare everywhere. A trained efficient force can then be concentrated in the central towns, where it will take several years to secure extermination. It is both safer and more economical to work six experienced men over a certain piece of ground in one year than to employ one man there six years, and both the time required and the risk of dissemination incurred are less in proportion as the number of experienced men employed is greater. We cannot hope to have an accurate account of the condition of every part of the infested region, or the progress made, unless an inspection of the entire area by expert men is carried on continuously throughout each year.

Having shown that a larger appropriation is necessary, the next question is, —

Will the Extermination of the Gypsy Moth if attained justify the Expense which must be incurred?

In judging of the probable destructiveness of the gypsy moth, should it be allowed to spread throughout the United States, it is important to know, first, how destructive it has been in Europe and other countries; second, whether it has proved or is likely to prove more destructive here than there.

Destructiveness of the Gypsy Moth in Europe.

In regard to its history in Europe, Professor Fernald wrote in 1889: "In 1817 the cork oaks of Southern France suffered severely from the attacks of this insect. One of the papers of that time stated that the beautiful cork oaks which extended from Barbaste to the city of Podenas were nearly destroyed by the caterpillars of the gypsy moth. After having devoured the leaves and young acorns they attacked the fields of corn and millet, and also the grasslands and fruit trees. In 1878 the plane trees of the public promenades of Lyons were nearly ruined by this same insect. Only last summer (1888) I saw the moths in immense numbers on the trees in the zoölogical gardens of Berlin, where the caterpillars had done great injury; and the European works on entomology abound with instances of the destructiveness of this insect. When we consider its long list of food plants, we can see how injurious this insect may become if allowed to spread over the country, and become established. The opinion was expressed to me by prominent entomologists in Europe, that, if the gypsy moth should get a foothold in this country, it would become a far greater pest than the Colorado potato beetle, because it is so prolific, and feeds on so many different plants, while the potato beetle confines itself to a small number." *

Bechstein of Germany says, in his "Natural History of Insects Injurious to Forest Trees" (1804, p. 372): "This is a formidable insect, against which very active measures must be taken; for, on account of their large broods and great voracity, the damage done by the caterpillars may be easily understood." Linnæus and Fabricius call it the pest of the fruit garden. Preyssler writes: "The caterpillars became very common in Prague, to the great injury of the fruit trees; being deprived wholly of leaves, they bore no fruit." P. Brocchi, in his "Treatise on Agricultural Zoölogy" (p. 451), published in 1886, says of the gypsy moth: "It attacks not only fruit trees, but forest trees also. It has been noticed that the gardens in the vicinity of elms and poplars have especially suffered." J. O. Westwood (London, 1840, p. 451) writes: "*Hypogymna* (*Ocneria*) *dispar* and *Psilma monacha* are occasionally exceedingly destructive in Germany to the forests, which they completely strip of their foliage."

Mr. E A. Samuels, in a paper read before the Massachusetts State Board of Agriculture, in 1865, speaks of the serious injury by this insect in Europe as follows: "During the year 1848 an enormous quantity of the *Bombyx* (*Ocneria*) *dispar*, a well-known enemy of their gardens and forests, had devoured the foliage of the trees, which in some localities were quite bare. In the autumn millions of their eggs were discovered, enveloped in a silky sort of covering, and attached to the trunks and branches. Many were removed; but the hand of man was powerless to work off the infliction, and the owners of the trees resigned themselves to their loss." * The insects were finally checked by the birds, which ate their eggs. For the past few years this insect and another allied species (*Gastropacha monacha*) have been very destructive in some parts of Germany, — so much so, in fact, that the Prussian government has probably expended more money in its efforts to control them than the State of Massachusetts has expended here in the attempt to exterminate the gypsy moth.

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* Spec. Bull. Hatch Exp. Station of the Mass. Agr. College, Nov., 1889, p. 4.

The Increased Destructiveness of Introduced Insects.

The following quotation, from the first annual report of the injurious and other insects of the State of New York, by J. A. Lintner, State entomologist, is given to show how much more destructive imported pests have become here than in their native countries: —

" It is well known to entomologists that those of our insect pests which are of European origin have become far more injurious here than they were ever known to be in their native homes. This may be illustrated by a reference to a few of our injurious species. The wheat-midge, introduced to this country about the year 1820, and first observed in northern Vermont (Fitch, Sixth–Ninth Reports Insects, New York, 1865, p. 8), has never throughout its entire European history, extending over nearly a century and a half, displayed an approach to the destructiveness which it has shown since its advent here.

" The ravages of the cabbage butterfly (*Pieris rapæ*, Linn), brought to this country by the way of Quebec, about the year 1858, have greatly exceeded those committed by it in Europe. It has proved very destructive to cabbages wherever it has appeared, and it seems destined to spread over all the United States, as it crossed the Missouri River in 1880 and has entered Nebraska. ('Canadian Entomologist,' xiv, 1882, p. 40.)

" The asparagus beetle (*Crioceris asparagi*, Linn), which has at times destroyed entire plantations of asparagus upon our sea-board in the vicinity of New York, has been known for centuries in Europe, but has hardly been referred to by writers on economic entomology as an injurious insect. Although common in Russia, a writer in referring to it, in 1880, states that it is never known to be obnoxious there.

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* Agriculture of Mass., 1865, p 116.

"The carpet beetle (in Massachusetts commonly known as the buffalo-bug) (*Anthrenus scrophulariæ*, Linn), first known in this country in the year 1872, has been recognized as a common species throughout a large part of Europe for more than a century. While in several portions of the United States its ravages on carpets have excited serious alarm in housekeepers, and have threatened to compel a resort to uncarpeted floors, no instance is known of its ever having been detected in feeding upon carpets in Europe, although stated to be injurious to furs, clothes, animal collections, and even leather and dried plants. More frequent reference is made by European writers of the occurrence of the beetle upon flowers than of the larva in houses. (Hagen, in 'Canadian Entomologist,' x, 1878, p. 161.)

"The increased ravages of our introduced insects result from the new conditions under which they are here placed. The relations that during the lapse of centuries have grown up between them and their food-plants, their insect parasites, the birds and other animals that preyed upon them, whereby a balance and an interdependence had become established, have all been broken up. When brought to our shores they find, perhaps, more abundant food, of a character more acceptable and attractive to them. But, mainly in their importation, their natural parasites and the enemies which had kept them in subjection have been left behind, and they are free to ply their destructive work and to 'increase and multiply' without hindrance or molestation, unless some of our native parasites shall at length acquire the habit of preying upon them, and other foes discover that they are 'good for food.'"

As an instance of the increased destructiveness of introduced insects, the case of the grape phylloxera (*Phylloxera vastatrix*) is well known. This insect is a native of America, and was carried to Europe in some way, where it was first noted in France by Professor Planchon, in 1868. It has been long known in America as an insect which does considerable damage to the leaves of native grapes, but before its introduction in France it was never considered a serious pest in this country. Since 1868, notwithstanding the most vigorous efforts to destroy it and prevent its spread, it has increased to such an extent and become so destructive as to almost annihilate the vineyards of southern France. Notwithstanding a reward equal in value to sixty thousand dollars, offered by the French government for the best means of destroying it, and an expenditure by the same government which was increased year by year, and which was in 1882 two hundred thousand dollars, it continued to spread, and its ravages since have probably cost several hundred millions of dollars. Hundreds of thousands of acres of vineyards have been rooted up and burned.

It was only after the lapse of about twenty years that means which were found and put into general use subdued the ravages of the pest in the vineyards of France so that grapes could be cultivated with any reasonable certainty of profit, and the vinegrowers are still at a great expense fighting the phylloxera in France. In 1889, two hundred and forty thousand acres of vineyard underwent defensive treatment. In the mean time it had pushed its way rapidly in other countries; it has now reached Algeria, Spain, Italy, Switzerland, Germany, Russia, Portugal, Australia, New Zealand, Brazil, Asia Minor and the Cape of Good Hope. Spain and Italy have already suffered very severely. In the former, small proprietors are forced to the necessity of abandoning the cultivation of their fields, and emigration from that country to Brazil reached the number of eleven thousand persons from Malaga between April and August, 1889. ("Insect Life," vol. 3, p. 185; vol. 1, p. 383.)

In 1889 there were in the north of Portugal ninety thousand acres of vineyards which had been killed by the phylloxera. This great damage has all been done by this little insect in the face of great efforts and expenditures by both governments and individuals to discover and use to advantage the most effective means of destroying it. It is said, however, that *it makes no progress in Russia and Germany, owing to the liberal, wise and vigorous policy of these governments in meeting it and stamping it out.* They have profited by the experience gained in France, and have spared no expense whenever it has appeared.

Damage done by Insects to Crops in the United States.

A glance at the history of such insect depredations as have been recorded in this country during the present century will impress all with the grave danger incurred in allowing this pest to propagate and spread.

The following figures, given in round numbers, in regard to the destructiveness of insects in this country to the crops, are taken from the reports of such eminent entomologists as Dr. A. S. Packard, Jr., of Brown University, formerly of the United States Entomological Commission, Dr. J. A. Lintner, State entomologist of New York, James Fletcher, government entomologist and botanist of the Dominion of Canada, from the reports of Dr. C. V. Riley, the entomologist of the United States Department of Agriculture, the United States Statistician, and other standard authorities.

Most of these figures have been compiled by conservative men, and have been repeatedly verified.

Hessian Fly.

(*Cecidomyia destructor*, Say.)

1846.	Destroyed almost the entire wheat crop of upper Georgia. (3d Rep. U. S. Ent. Com., p. 200.)	
1846.	Loss in western New York, five hundred thousand bushels. (3d Rep. U. S. Ent. Com., p. 200.)	
1885.	Wayne and Ontario counties, New York, . . . (4th Ann. Rep. Injurious and Other Insects of New York State, by Dr. J. A. Lintner, p. 11.)	$100,000

Army Worms.

(*Leucania unipuncta*, Haw., and other species.)

1861.	Did damage in eastern Massachusetts exceeding . (Rep. A. S. Packard, Jr., in Agr. of Mass., 1870, p. 353.)	$500,000
1887.	Iowa, loss to grain in two counties, ... (Rep. Prof. H. Osborn to Ent. U. S. Dept. of Agr., 1887, p. 160.)	180,000
1887.	Iowa, total loss exceeded . . . . . . (Rep. Prof. Herbert Osborn to Ent. U. S. Dept. Agr., 1887, p. 160.)	500,000

European Cabbage Butterfly.

(*Pieris rapæ*, Linn.)

	Annual loss of cabbages about Quebec, Can.,* . . . (Abbe Provancher.)	$250,000
1870.	Loss near New York City, over * . . . . . (American Agriculturist, 1870.)	500,000

Wheat Midge.

(*Diplosis tritici*, Kirby.)

1854.	Loss in New York State alone, † . . . . (Estimates made by Sec. N. Y. State Agr. Society, given by Dr. Fitch, State Entomologist.) So destructive was this insect in the years following 1854 in New York as to stop the raising of white wheat and reduce the value of all wheat lands forty per cent. ‡	$15,000,000
1856.	Loss in Canada, ... (A. S. Packard, Jr., Rep. on Rocky Mt. Locust, 1877, p. 709.)	2,500,000
1857.	Loss in Canada, eight million bushels. (J. A. Lintner's 1st Rep. on Injurious and Other Insects in the State of New York, p. 7.)	

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* Rep. on Rocky Mt. Locust, Dr. A. S. Packard, U. S. Geo. Survey, 1877, p. 747.

† Lintner's 1st Ann. Rep., p. 6. Albany, 1883.

‡ Packard, Rocky Mt. Locust, p. 709.

Cotton Worm.

(*Aletia argillacea*, Hübn.)

1788.	Destroyed two hundred tons of cotton in the Bahamas. (Dr. A. S. Packard, Jr., Rep. on Rocky Mt. Locust, U. S. Geo. Survey, 1877, p. 776.)	
1793, 1800, 1804, 1825 and 1826,	very destructive in this country, and has since been destructive somewhere nearly every year. (Dr. A. S. Packard, Jr., Rep. on Rocky Mt. Locust, U. S. Geo. Survey, 1877, p. 776.) Average loss in cotton States for fourteen years following the war, each year, *	$15,000,000
1873.	Damage in cotton States, (4th Rep U. S. Ent. Com., p. 3.)	25,000,000
	Later average annual loss from $25,000,000 to	†50,000,000

Chinch Bug.

(*Blissus leucopterus*, Say.)

1850.	Loss in Illinois, (Computed by B. D. Walsh, State Ent. of Ill.)	$4,000,000
1864.	Loss in Illinois, (1st Ann. Rep. of Injurious and Other Insects of N. Y. State, by J. A. Lintner, Albany, 1882, p. 7.)	73,000,000
1864.	Total loss in Mississippi valley, (Dr. Shimer's notes on chinch bug, as given by A. S. Packard in Rep. on Rocky Mt. Locust, 1877, p. 697.)	100,000,000
1871.	Loss in Illinois to wheat, oats and barley, (Dr. LeBaron, 2d Rep. State Ent., Ill.)	10,000,000
1871.	Loss in Indiana, Iowa, Nebraska, Missouri and Kansas, (Dr. LeBaron, 2d Rep. State Ent., Ill.)	30,000,000
1874.	Loss in Missouri, (Prof. C. V. Riley, 7th Rep. Insects of Missouri, 1875 p. 25.)	19,000,000
1874.	Loss in Western States, (Prof. C. V. Riley; Packard, Rocky Mt. Locust, p. 698.)	60,000,000
1887.	Total loss in nine States, ‡ (J. R. Dodge, Statistician U. S. Dept. Agr.)	60,000,000

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* 4th Rep. U. S. Ent. Com., p. 3.

† Rocky Mt. Locust, Packard, p. 591.

‡ Rep. of Ent., U. S. Dept. Agr., 1887, p. 56.

Grasshoppers. (*Rocky Mountain Locust.*)

(*Caloptenus spretus*, Uhler.)

1874.	Damage done to corn and staple crops in Kansas, Nebraska, Iowa and Missouri, ... (First Rep. of U. S. Ent. Com., 1877, p. 121.)	$56,000,000
1874.	Total loss to the four States, ... (First Rep. of U. S. Ent. Com., 1877, p. 121.)	100,000,000
1874.	Total loss in these and neighboring States by damages, suspension of business, etc., . . . ("Insect Life," vol. 3, p. 397.)	200,000,000
1874–1877.	Damage in the United States, ... ("Insect Life," vol. 2, p. 216.)	200,000,000
1875.	Twenty-six counties in Missouri, * . . . . (Prof. C. V. Riley)	15,000,000

ESTIMATES, — AVERAGE ANNUAL DAMAGE BY INSECTS IN THE UNITED STATES TO STAPLE CROPS.

1868.	B. D. Walsh in the American Entomologist, $200,000,000 to	$300,000,000
1877.	Dr. A. S. Packard estimates that it exceeds . .	200,000,000
1884.	Variously estimated at from $300,000,000 to . . (Riley and others.) †	400,000,000
1891.	James Fletcher, ‡ . . . . (Entomologist Dominion of Canada.)	380,000,000

Most of the foregoing figures represent the damage done by insects which eat certain of our most important crops, or by those which accumulate in vast numbers, and by sweeping over a region devour nearly every green thing, and so are most conspicuous. Such insects attract a greater share of the public attention than many other species which are widely spread and possibly equally injurious, but which appear regularly in comparatively small numbers over a wide area, and whose depredations are local, annual and perennial. Among these may be reckoned such insects as the June beetle, the rose beetle, the codling moth, many cut worms, and forest insects, some of which are continually injurious over large areas, but whose ravages are not usually especially noticeable except in particular localities.

In proof of this, Dr. Lintner says *that the regular and periodical damage done by cut worms in this country, each year, would probably exceed that of the Rocky Mountain locust.*

It is quite probable, were all the various losses and expenses directly or indirectly connected with the problem of insect damages, and protection therefrom, included in these estimates, that the sum total would be considerably increased. The figures given by Mr. Fletcher, $380,000,000, represent one-tenth of the value of the entire yearly agricultural products of the United States. "This sum," he says, "is given up without a murmur and almost without a struggle by the people of the United States;" and he has stated, in his report before the committee on agriculture of the Canadian House of Commons, July 4, 1891, that insects destroy one-tenth of all of the crops of the Dominion of Canada. These estimates are borne out by the estimates made from time to time of the damage done in towns and counties in different States.

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* 8th Report on Missouri Insects, 1876, p. 90.

† Rep. of U. S. Dept. of Agr., 1884, p. 324.

‡ "Insect Life," vol. 4, p. 13.

Why the Gypsy Moth is More Destructive than our Native Insects.

It was introduced without its native enemies.

Its reproductive capacity is enormous

The eggs contained in egg clusters have been counted, and in some of them over fourteen hundred have been found. It is probable that the average number given in my last report (four hundred and sixty-eight) was not the full complement for one female, as some females deposit their eggs in more than one cluster. The average number of eggs laid by each female is probably between six and seven hundred.

The caterpillars are very voracious, not even the army worm is more so, and the amount of food that one can consume is enormous. *It has become acclimated in Massachusetts, and it is very hardy.* Cold does not affect the eggs.

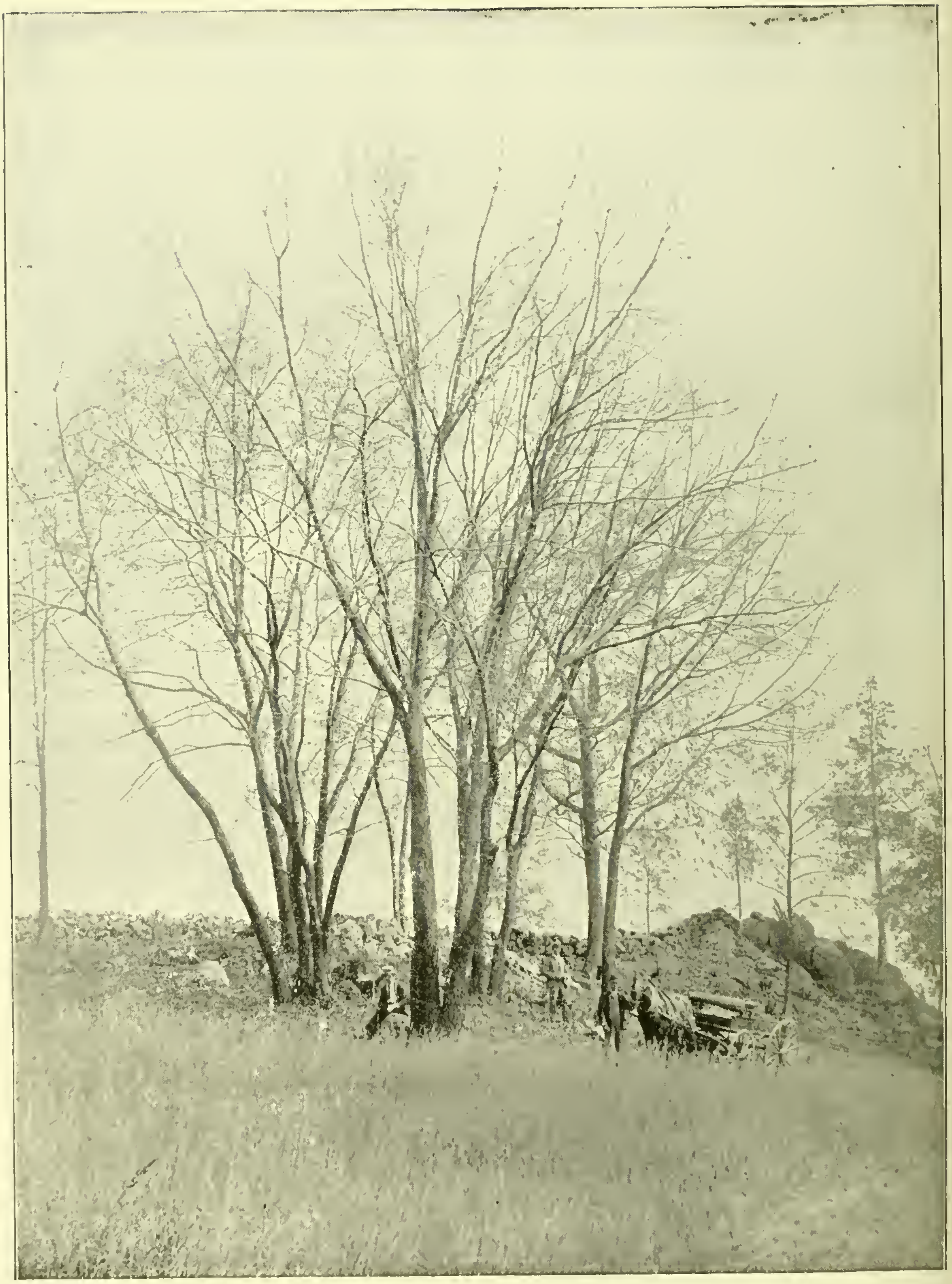
It seems adapted by nature to almost any kind of plant food, so that, if it is exterminated from the orchard or garden or driven into the field or forest, it can multiply there, and again overwhelm the orchard. In this it has the advantage of such other pests as feed on a few species of plants.

As young are continually hatching from April until the middle of June, and are feeding throughout the late spring and the entire summer, *the feeding season is unusually long.*

When not numerous it is not conspicuous, as when the caterpillar is well grown it feeds at night, hides during the day, and has no nest or web like that of the tent caterpillar; therefore it is likely to be overlooked, and the damage done by it attributed to some other insect, until it has become so numerous as to discourage efforts to destroy it.

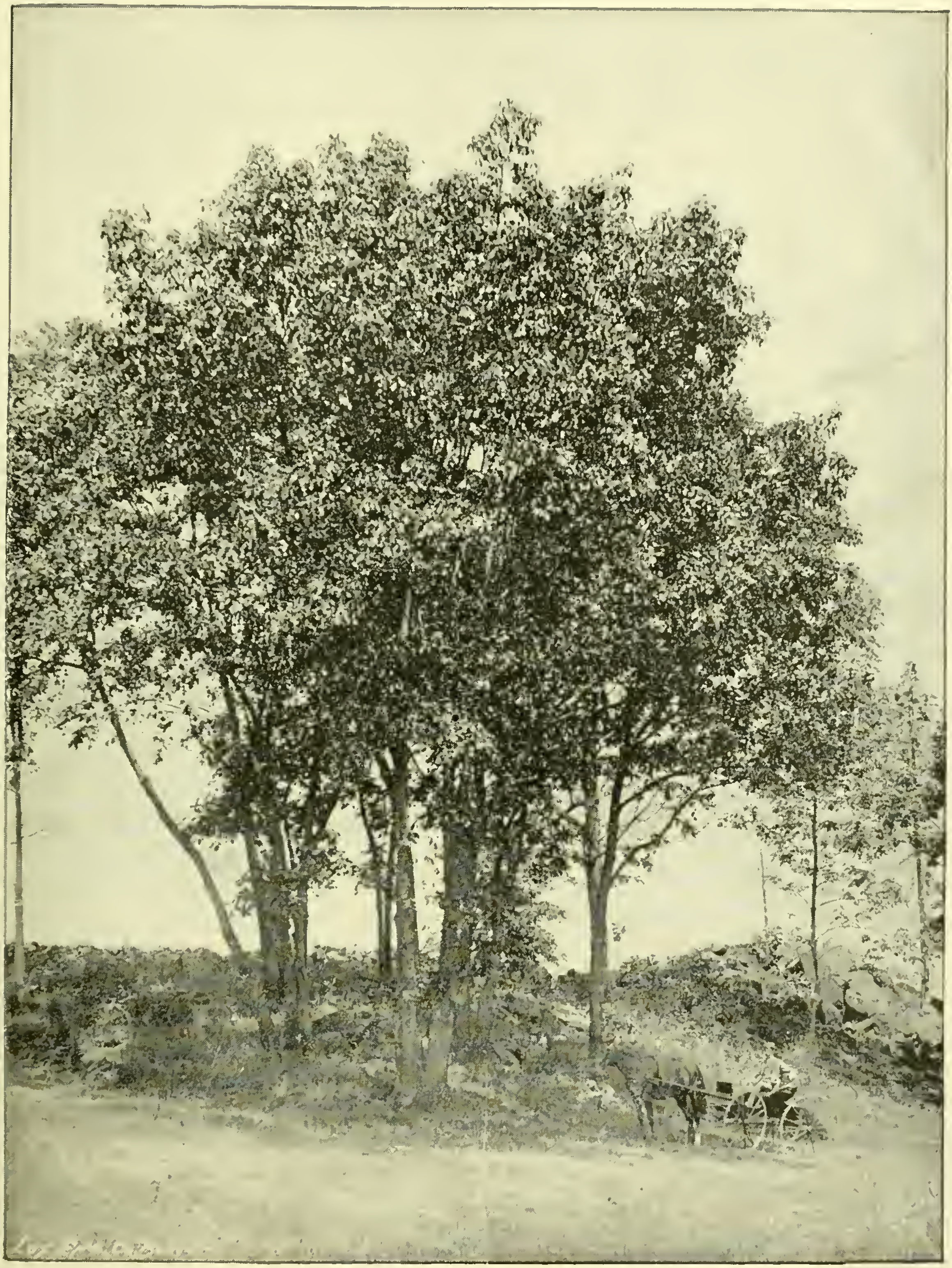
The Increase and Destructiveness of the Gypsy Moth in this Country.

"The fact that this insect has now been in this country for the last twenty years, and has not only held its own but has multiplied to such



Trees stripped by caterpillars of the gypsy moth, Arlington, Mass

From a photograph taken July 9, 1891.



View of the same trees, showing the result of the work done there in 1891 and 1892 by the agents of the State Board of Agriculture.

From a photograph taken July 9, 1892.

an extent as to cause the entire destruction of the fruit crop and also to defoliate the shade trees in the infested region, is sufficient cause for alarm. The citizens of Medford are immediately interested, but the entire Commonwealth and country are threatened with one of the worst insect pests of all Europe." * No one who has not witnessed the vast increase and the insatiable voracity of the caterpillars of this moth in this country can appreciate the dangerous character of the pest. Where they are allowed to go on unchecked, they strip trees, shrubs, vines and vegetables of their foliage, and will even gnaw the stems and twigs. Their numbers and appearance at such times are well described by Mr. J. O. Goodwin, in the "Medford Mercury" in 1890: "After devastating my neighbor's trees, they marched in myriads for my premises, fairly covering the fences, houses, outbuildings, grass land, currant bushes and concrete driveways with their trooping battalions." Again he says: "The number of worms cultivated on the three or four worthless trees on the premises adjacent to my own is astonishing; numbers fail to convey an adequate idea. The earth seemed to be covered with them."

From the experience with other introduced insects we are led to believe that the unchecked dissemination of this pest, if allowed to continue, will prove a great, growing and enormously expensive evil. As in the past, the efforts of small land owners would not be sufficient to protect their orchards, shade trees and gardens from the vast hoards that would breed unmolested in the woods.

As the moth is distributed in a great measure by vehicles, it makes its appearance first where teams stop, and begins its work of destruction in the door-yard, orchard and garden. Thus the danger to the forest, in case the moth were allowed to propagate unchecked, would be comparatively remote. As the apple tree is one of its particular favorites, there would be another dangerous pest added to those which now sap the life of this tree. If the trees were banded, the caterpillars would attack the currant, quince, rose, cabbage and other garden plants. No doubt the people would learn in time how to destroy them. In fact, the results of the investigations and experiments made under the direction of the committee would, if published in full, give information which would be most useful in dealing with this and some other pests; but the expense would then, as now, fall on the people of the State; it would at first fall heavily on a few, and would grow greater and more widely distributed year by year.

The Colorado potato beetle (*Doryphora 10-lineata*, Say), which has done many millions of dollars' worth of damage in this country, was at first a serious pest in Massachusetts. Its ravages have been somewhat lessened at the present time, as the farmers have learned how to destroy it; but Professor Fernald, who has obtained the most accurate figures from farmers in all parts of the State in regard to the cost of the Paris green applied to the potato crops to hold this insect in check, estimates that the tax upon the farmers who use Paris green for this purpose is seventy-six thousand dollars annually in Massachusetts.

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* Prof. C. H. Fernald in Spec. Bull. Hatch Exp. Sta., Amherst, 1889.

In view of the well-known destructiveness of imported insects in this country, with such knowledge as we have of the habits and destructiveness of this insect both here and abroad, with due consideration of the progress already made toward extermination, it would seem the part of wisdom and economy to continue the work with the most liberal appropriations, until the gypsy moth is extinct in Massachusetts.

Respectfully submitted,

E. H. FORBUSH.

Entomologist's Report.

To the Members of the Gypsy Moth Committee.

Gentlemen: — During the past year I have made frequent visits to the territory infested by the gypsy moth, and inspected the work of destroying the pest as carefully as possible.

The critical studies that have been made on the habits of these insects by the field director and his assistants, as well as by myself, have led to quite different methods for their destruction from those in general use with our native insects. Some of the methods that I at first recommended did not prove successful, because they were not adapted to the habits of this particular insect. I had at that time studied it only in confinement, and it was necessary to observe its actions on the trees, where it is entirely free, in order to learn its true habits and select such methods as prove most useful for its destruction.

When I first visited the infested territory in Medford, in September, 1889, there was a region of considerable extent where the branches and trunks of the trees were yellow with the clusters of eggs. This fall I spent three days with Mr. Forbush and four of his most experienced field hands searching for eggs, and we were able in all this time to find but two clusters, and no one who was not acquainted with the facts would have been aware that any uncommon insect occurred in all that region.

While I have for some time had grave doubts of the possibility of complete extermination, I am now led to believe that such a thing is really possible, provided the work be continued for several years with sufficient appropriations to keep the entire territory under careful supervision. This is a case where only skilful, experienced and faithful men should be employed; for, if the work should be slighted in any way, it would be greatly prolonged, and therefore all the more expensive to the Commonwealth.

From a careful examination of the reports of those in charge of the sections, and also of the territory under their supervision, it seems quite probable that the insect has been exterminated in certain localities; but it would be very unwise not to continue a careful inspection of these localities until there can be no possible doubt about the matter, and in time by this method the area to be kept under examination will be lessened, and consequently the annual expense gradually reduced.

A careful search was made last year for parasites on the gypsy moth, and the following species were found, some of which were determined by myself and the others by gentlemen who have made a special study of the groups of insects to which these belong. They were as follows: —

Destroying the Eggs.

Trombidium bulbipes, Pack., determined by Prof. Herbert Osborn.
Nothrus, *near ovivorus*, Pack., determined by Prof. Herbert Osborn.
Phlœothrips, sp? determined by Prof. Herbert Osborn.

A minute *Hymenopterous* insect was bred from the eggs and accidentally lost before I had an opportunity to see it.

Living within the Caterpillars and emerging after they transform to Pupæ.

Theronia melanocephala, Br.
Meraporus, sp? determined by Mr. L. O. Howard.
Anisocyrta, sp? determined by Mr. E. T. Cresson.
Exorista, two species, determined by Dr. S. W. Williston.
Phorocera, four species, determined by Dr. S. W. Williston.

The above are true parasites.

Gaurax anchora, Loew, determined by Dr. S. W. Williston.

Osten Sacken has observed the larvæ of this species in multitudes devouring the pupæ inclosed in the cocoons of the *Cecropia* moth.

Phora scalaris, Loew, determined by Dr. S. W. Williston.
Phora incisuralis, Loew, var., determined by Dr. S. W. Williston.

The last three species are regarded by Dr. Williston as accidental parasites, entering the pupæ of the gypsy moths while the flies are in the larva state, and then feeding in and destroying the moths.

Sarcophaga, two species, determined by Dr. S. W. Williston.

Schiner expresses very grave doubts whether the species of *Sarcophaga* ever feed on anything but dead animal matter, while Brauer states that their larvæ are sometimes parasitic.

Cyrtoneura stabulans, Fall., determined by Dr. S. W. Williston.

According to Hartig and Bremi, the larva of this species is sometimes found in the larvæ of certain *Bombycid* moths.

One of the true bugs, *Podisus spinosus*, Dall., was often found destroying the caterpillars of the gypsy moth, and predaceous beetles, ants, spiders, toads and poultry were also found at the same work, while no less than twenty species of birds were observed feeding on the caterpillars.

After consulting with Drs. Farlow and Thaxter on the subject, it was deemed impracticable to attempt the use of vegetable parasites in destroying the gypsy moth.

Respectfully submitted,

C. H. FERNALD.

SECOND ANNUAL REPORT

OF THE

DAIRY BUREAU

OF THE

Massachusetts Board of Agriculture.

REPORT OF THE DAIRY BUREAU.

To the Senate and House of Representatives of the Commonwealth of Massachusetts.

The law creating the dairy bureau went into effect Sept. 1, 1891, and is therefore only one year and four months old.

During this brief period much time has been necessarily expended in the details of organization, in the making of plans, and in other matters of preliminary routine; for the dairy bureau was an entirely new department of the State machinery, without traditions or precedents to aid it in getting into operation. In addition to this, the members of the bureau, with their executive officers, were unfamiliar with the class of duties imposed upon them by the statute; consequently this first record of a full year's work cannot report as great achievements as we hope will be possible with more experience and greater familiarity with our duties and responsibilities.

Chapter 412, section 7, of the Acts of 1891, says that the bureau is " subject to the general direction and control of the Board of Agriculture," but its particular duties are defined in section 11 of the same chapter, as follows: —

> To investigate all dairy products and imitation dairy products bought or sold within the Commonwealth;
>
> To enforce all laws for the manufacture, transfer and sale of all dairy products and all imitation dairy products within the Commonwealth, with all powers needed for the same;
>
> To investigate all methods of butter and cheese making in cheese factories or creameries; and
>
> To disseminate such information as shall be of service in producing a more uniform dairy product of higher grade and better quality.

This very comprehensive law includes educational and police duties, and can be enforced in such a broad manner as to enhance the interests of consumers and producers of dairy products, of dwellers in both city and country. It has been the aim of the bureau to make its work of service to the whole community.

The executive department of the bureau remains the same as at the time of its report a year ago. Wm. R. Sessions, secretary of the Board of Agriculture, is by statute the responsible executive officer; but most of the actual executive work falls upon his assistant,—appointed by the governor,—Geo. M. Whitaker. In addition to these executive duties, Mr. Whitaker has also been placed by the bureau in immediate charge of the educational department of the work. J. W. Stockwell continues an agent of the bureau for securing evidence of the violation of the laws in relation to the sale of oleomargarine.

The Police Department.

The statute gives the bureau authority to enforce all the laws relating to all dairy products, but in the brief time the law has been in operation, and with the means at our disposal, there has been opportunity to take up only the oleomargarine laws. These laws are in brief as follows: —

1. Requirements for branding boxes and tubs and for marking wrapping paper, with a penalty for false marking or branding.
2. A prohibition of the use of the word "dairy" or "creamery" on any tub or package.
3. A requirement for licensing a dealer and a conveyer.
4. A penalty for selling oleomargarine as butter.
5. Requirements for signs on stores and wagons.
6. A prohibition of the sale at hotels and restaurants without giving notice.
7. A prohibition of the sale of any imitation of yellow butter.

Laws regulating the sale of oleomargarine were first passed in this State in 1881, and, as experience showed the need of more and more restrictive measures, additional legislation was enacted in 1884, 1885, 1886 and 1891. The absolute prohibition of the sale of any imitation of yellow butter is the most important, as it is the most restrictive, of all this legislation. This measure was hotly contested in the Legislature for several years, and it has been opposed with equal vigor since its enactment. The first cases brought under it (chapter 58 of the Acts of 1891) were rapidly advanced to the supreme court. In point of time this law was passed before chapter 412 of the same year, which had other restrictive measures, though both went into effect at the same time. It was argued that the anti-color law (chapter 58) was repealed by implication by the enactment of chapter 412. The supreme court refused to sustain this point. The claim was also made that the law in question was unconstitutional, as interfering with interstate commerce, the oleomargarine in question being the product of other States, and sold in the original package. This point, too, was overruled by the supreme court, on the ground that it is within the police powers of the State to pass laws prohibiting the sale of an imitation article, in the interest of honesty and fair dealing. The court said, "The question is, may a State protect itself against articles so prepared as to deceive the public?" To this question the court said, "Yes."

This is in accordance with the spirit of the decision of the United States supreme court in the case of a prohibitory oleomargarine law in Pennsylvania, by which it was declared that a proper exercise of the police power of the State is not an unlawful interference with interstate commerce. This decision of the State supreme court sustaining the law was not rendered till early in May, and not until about the first of June would district and municipal courts entertain complaints for selling an imitation of yellow butter. Hence for nine months of the existence of this law it has been inoperative by reason of its status being uncertain. Although this has greatly interfered with our work, it has not prevented its prosecution with what vigor was possible. The detective officer of the bureau kept faithfully at work, getting evidence of the violation of this and the other oleomargarine laws. The decision of the court was received so late that complaints for earlier infractions of the law were dropped for new ones on fresher evidence. Our work in this department has been largely confined to places outside of Boston, as, under the provisions of law allowing us to work in harmony with milk inspectors, we have practically left the Boston field to Dr. Harrington, as, with his wide experience, the more liberal funds at his command, and a disposition impartially and thoroughly to enforce all the laws within his jurisdiction, we felt he could do better than we could, and that it would be a more economical use of our appropriation to expend it in other parts of the State.

The clause of the law suggesting that the bureau may act in harmony and unison with the Board of Health and milk inspectors has worked excellently, so far as the Boston milk inspector is concerned. We are indebted to Dr. Harrington for many valuable suggestions, growing out of his long experience, and in return we hope we have been of some help to him, particularly in furnishing him in court with needed technical evidence on dairy matters. An officer of the bureau has appeared in court as a witness for him in about twenty cases. Such reciprocal favors have, we trust, helped both sets of officers, and increased the efficiency of the enforcement of the law.

The decision of the Massachusetts supreme court, sustaining the anti-color law, was appealed to the national supreme court; and this action, it was claimed by the oleomargarine lawyers, continued to keep the law in suspense. But our legal advisers did not coincide with this view, and, as a result of the entry of several cases in court, a bill in equity was brought in the United States court of appeals for an injunction to restrain Dr. Harrington from enforcing the law. This has been postponed from time to time, and has not been argued yet.

In enforcing these laws, the greatest number of cases has been brought for selling an imitation of yellow butter, and these cases have been stubbornly contested in New Bedford, Boston, Springfield, Holyoke, Uxbridge, Worcester and elsewhere. The defence has been that oleomargarine is an independent article of commerce, and hence that it is not an imitation of butter or any other commodity; that motive should be proved to prove imitation; also that the standard set up — yellow butter made from unadulterated milk or cream — does not exist commercially, lacks fixity of shade, is hypothetical rather than actual. In spite of these contests, ably made, convictions have been secured in all the lower courts, all of which have been appealed. Only one appealed case has been tried before the superior court. At the Suffolk County session held last month one was tried; the decision of the lower court was affirmed by the jury, who found the defendant guilty. The case was then appealed to the supreme court, on law points, and another attempt will be made to break down this statute.

The law relative to marks on tubs or boxes requires the word "oleomargarine" or "butterine" to be "stamped, labelled or marked in a straight line in printed letters of plain, uncondensed Gothic type, not less than one-half inch in length, so that said words cannot be easily defaced, upon the top, side and bottom of every tub, firkin, box or package containing any of said article, substance or compound." This law was evaded by placing the tubs in groups, so that the marks on the bottom and side would not show, and then removing the cover, for the alleged purpose of displaying the goods. For a while the Boston milk inspector required a card bearing the words "oleomargarine" or "butterine" to be placed upon the open tubs in such cases. But eventually the supreme court decided that such a construction of the law was unwarranted. Hence section 2, chapter 412, of the Acts of 1891, was enacted, which provides for an additional sign "*upon every opened tub.*" But the dealers now place the opened tubs on their sides, in pigeon-hole-like receptacles, with this extra sign *upon* the opened tub; it is, however, concealed by the receptacle, so that there is still nothing visible to show the nature of the contents of the tub. In several cases municipal court judges have decided that the letter of the law has thus been complied with. Consequently this law is inoperative, and will need amendment if the intended restriction is to be preserved. We recommend that this law be amended so as to read as follows, the words in italics being those that should be added: —

SECT. 2. Whoever exposes for sale oleomargarine, butterine or any substance made in imitation or semblance of pure butter, not marked and distinguished by all the marks, words and stamps required by existing laws, and not having in addition thereto *conspicuously* upon *or across the surface of the exposed contents of* every opened tub, package or parcel thereof a placard with the word "oleomargarine" printed thereon in plain, uncondensed Gothic letters, not less than one inch long, shall be fined not less than one hundred dollars for each offence.

The bureau has also had a few cases for selling oleomargarine when butter was called for, one for sale in a hotel, one for lack of signs on a wagon, and several for improperly stamped wrapping paper.

The detective officer of the bureau has made four hundred and eighty-six visits of inspection to stores or places where oleomargarine is sold ; in these he has purchased one hundred and eighty-four samples. The chemical analyses have been made by the State Experiment Station, Dr. B. F. Davenport and Professor Kinnicutt of the Worcester technical school.

Although our work has been hampered by our inexperience, by the newness of the laws, and by the anti-color law being inoperative during a considerable portion of the year, we feel that the legislation under which we act has been of much value in preventing dishonest practices and in restricting the sale of "oleomargarine, which is deceptive, and which is designed and is likely to be passed off for something different from what it is." The clause in quotations is the language of the Massachusetts supreme court. Much oleomargarine is still sold, however ; a system of selling upon orders has been devised, by which a licensed wholesaler sends out trusty salesmen to take orders from only known parties, the goods being delivered and billed from the main store. We have reason to believe that the oleomargarine dealers in the State are banded together in a strong organization, which receives material sympathy from the large manufacturers. In nearly all of the cases which have been tried, from New Bedford to Holyoke, the same attorney has appeared for the defence, showing that they are associated together in order to defy and if possible break down the law, and, if defeated, share the costs and penalties when a member is convicted.

One of the arguments advanced for the passage of the law creating the dairy bureau was that such a body could arrive at authoritative and official information as to the extent and nature of the oleomargarine business; for many apparently contradictory statements were made in the arguments before legislative committees and in the Legislature itself. On the one side were many scientific gentlemen, who testified as to the wholesomeness of oleomargarine and its desirability as a food product; on the other hand were those interested in the prosperity of agriculture, asking for relief from what they considered an unjust competition with honest butter.

The facts as they appear to the bureau after its brief experience are that there is some truth in both claims. To a certain extent the old story of the shield is repeated.

We are not prepared to dispute the statements of honest scientists in relation to the value of oleomargarine; we are ready to admit that there is a theoretical oleo, which, if put upon the market honestly, on its merits as an independent article, might have proved an important addition to the world's food products. But the ordinary commercial oleomargarine with which we have to deal seems in many cases to exert a benumbing influence on the moral sensibilities of those who handle it. There seems very little disposition to sell it "in a separate and distinct form, and in such a manner as will advise the consumer of its real character." Every attempt to secure, by legislation, such a manner of selling oleomargarine has been vigorously opposed. From the start it has been made to look like butter, has been sold in butter stores, and given all the nomenclature of the dairy. "Butter-ine" is even now a popular name for it, and, until the law prevented, "dairy butterine" and "creamery butterine" were common terms. Even now some manufacturing companies are incorporated as dairy companies, and we have seen in some stores such a sign as "Butterine from the Wooddale Dairy Company sold here." It is put up in butter tubs or in prints, it is colored with the article of commerce known as "butter color," and sold in butter stores, with the tubs of oleo and the butter tubs side by side. In Massachusetts it is a food product of great merit and value (*sic*), but in Pennsylvania it is "not sold as an article of food," because a judge there had decided that the government must prove that the defendant intended to sell it as a food.

So far as we are called upon, inferentially, to express any opinion upon the laws, we believe that the facts warrant their existence. The supreme court of Pennsylvania, in a decision quoted with evident approval by the supreme court of this State, says that when an article is put upon the market in such way that it may deceive the public, the Legislature of a State is not exceeding its police powers in even prohibiting the sale of that article, though it might under other circumstances be a harmless and even desirable article of benefit to the public.

The law is to be defended on the broad statement of universal application that imitation is closely allied with deceit, and that any imitation product should be side-tracked if it gets in the way of the regular original article.

The Educational Work.

This work has been extended in several directions, with a view of a broad foundation for the future and doing a present good to all classes of citizens of the State.

City Milk Supply.

Considerable has been done in a study of questions relating to the milk supply of large cities, Boston in particular. This has no great results to show as yet, but we believe that a good beginning has been made. The following statements will show something of the importance, need and possible methods of such work. Early in the year there appeared in a medical journal an article by Prof. W. T. Sedgwick of the Institute of Technology, on the amount of bacteria in city milk and the dangers which might result therefrom. His attention was immediately called to the dairy bureau and the powers given it by law, and he was invited to make some suggestions. From this correspondence we make these extracts: —

Geo. M. Whitaker, Esq., *Assistant Executive Officer, Dairy Bureau.*

Dear Sir: — The bureau might well investigate more fully the origin and history of the milk regularly sold in Boston, and some other large cities and towns, with especial reference to the place and method of its production, its pollution at the stable and *en route*, its freshness or staleness when delivered, and its keeping qualities as marketed. The object of such an investigation would be to learn where the milk comes from, under what conditions, good or bad, of temperature, exposure, etc., under which it is produced and transported; how long it is upon the railroad, how long in the hands of the peddlers. . . . It seems to me that it is the duty as well as the privilege of the bureau to inform the producers of milk of the fact of the dissatisfaction of physicians and the consumers with the present conditions of the milk purchased in the cities; of the reasons for such dissatisfaction, and of the remedies.

The fact is that city milk is often filthy . . . and always more or less stale. This is a fact of prime consequence to the makers of milk, and they should know of the dangers which threaten to injure their business. They should be told that the keeping qualities of milk depend almost wholly upon cleanliness; that short-lived milk is usually dirty milk; and they should be made to understand the value of chilled milk, and exactly why it preserves the keeping qualities. . . . The bureau might equip and send out a speaker who, being thoroughly informed, should visit and address societies, meetings, granges, etc. . . . They should urge the practical remedial measures of greater cleanliness and quicker transportation and delivery.

Pursuing plans already partly matured, and carrying out the suggestions of this letter, twenty-five meetings have been attended by an officer of the bureau, and addresses made on questions relating to the milk supply and other dairy topics. The assistant executive officer has been instructed to study these questions, and hold himself in readiness to respond to all calls from farmers' clubs, granges and agricultural societies so far as possible.

Creameries.

Something has been done by the bureau in the inspection of creameries. Some thirty such visits have been made; one cheese factory has also been visited. Cheese manufacturing in the State has about died out, but butter-making is on the increase. Most of the creameries are owned by co-operative associations, although there are a few which are proprietary. Most of the creameries are in a prosperous condition; those which are weak are suffering from purely local causes. The expense of manufacturing butter may range from eight to four cents per pound, dependent largely upon the amount manufactured and the location of those who furnish cream. If the cream gatherer has to drive past the residences of A, B, C, D and E to get F's cream, the expense of gathering is too great. It would not cost much more to stop at every house. Co-operation can be made a success only by co-operating.

In addition to this work, the bureau has placed its executive force at the service of the creameries of the State, as a clearing house of general information, and for such clerical work as may be of service and desired by them in collecting and tabulating statistics.

Dairy Schools.

Further work has been done by the dairy bureau in conducting dairy schools or conferences. This kind of educational work was a novelty in New England until inaugurated by this bureau. The idea was first suggested by the Bay State Agricultural Society, which set the ball in motion by paying one-half of the expense of two schools, — those held at Greenfield and Barre. Following these a school was held at the Agricultural College, for the benefit of the senior class; and later in the season four more were held, — at Framingham, Charlton, Cheshire and Gardner. At these meetings many kinds of the latest devices in dairy machinery were exhibited in actual operation. As the separators, the churns, the butter workers, the coolers and the aerators were operated, practical explanations were made and questions answered. Mr. James Cheesman had charge of the technical work, and the meetings seemed to be very profitable and interesting. Many travelled a considerable distance to attend them, and much good seemed to be done. The sight of the various forms of apparatus in actual operation gave the meetings an object-lesson value far beyond what would be possible from a mere lecture or discussion.

Babcock Milk Tester.

Another department of work in which much has been done has been the popularizing of the Babcock milk tester (which readily shows the amount of butter fat in milk), and testing milk and cream. This tester is one of the most important dairy implements of recent invention. One authority says that, if the experiment stations had done nothing but produce the Babcock milk tester, this one result would have been a good return for all the expense. By enabling the farmer readily to test the quality of the milk of each cow, he can weed out those which are unprofitable, and thus make his business more successful. He can also detect wastes in his dairy. The creameries will eventually pay for the cream they receive by this test. The bureau has made two hundred and ninety-eight tests of milk, cream, buttermilk and skim-milk.

Tests of cream showed a range of from 12 to 33 per cent of butter fats. The first was commercial cream, purchased in the open market in Boston, the last a sample of separator cream made at a dairy school at Greenfield.

Samples of buttermilk have been tested, with a range of from 3 per cent down to a mere trace of butter fat. About .30 is considered a good average.

The samples of skim-milk examined varied from .10 to .50 per cent of butter fats. The lowest samples of skim-milk were taken from the separator at the dairy schools.

The whole milk of individual cows examined showed a variation of from 1.80 to 9.80 per cent of butter fats. Samples testing 9.80 per cent and 9.20 per cent were from farrow Jerseys which had been in milk over a year, — one owned in Southbridge and one in Baldwinville. Both of these extremes are abnormal; from 3 to 6 per cent of butter fats will cover the majority of specimens, those below 3 and above 6 being about equal in number. Four tests were made of milk at different stages of milking. In one case the strippings contained as high as 11 per cent of butter fats. In two cases the result was as follows: —

First of the milking, 2 per cent; strippings, 8 30 per cent.
First of the milking, 1.40 per cent; strippings, 5.30 per cent.
First of the milking, 1.10 per cent; strippings, 7.80 per cent.

The following table shows the results of the tests of normal milk, as classified: —

Below 3 per cent butter fats, . . .	.17 per cent of the samples.
From 3 to 4 per cent butter fats, . .	.25 per cent of the samples.
From 4 to 5 per cent butter fats, . .	.32 per cent of the samples.
From 5 to 6 per cent butter fats, . .	.13 per cent of the samples.
Six per cent and over butter fats, . .	.12 per cent of the samples.

Large interests in the State are involved in the production of sale milk, and to these the law requiring 13 per cent of total solids is of interest and importance. As the solids other than fat are comparatively constant in all kinds of milk, and as the only element that changes very much is the fat, the Babcock test has a practical interest in the information it gives the farmer as to the total quality of his milk. The solids other than fat seldom vary more than three-quarters of one per cent, usually ranging from about 8.75 to 9.50. Usually milk testing from 3.70 to 3.80 per cent of fat is on the line of safety. Of the above samples, 33 per cent were below 3.80; 66 per cent were 3.80 or above.

The range of variation in individual animals is much wider than it is in the mixed milk of several animals. Any one producing milk for market will have a more uniform article, and be less liable to furnish milk below the standard, if he mixes the milk of several animals.

The samples of the mixed milk of herds tested by the officer of the bureau had a range of from 2.30 to 6.10 per cent of butter fats. Avoiding the violent extremes, the range was from 3.30 to 5 per cent.

Of all these samples of herd milk there were: —

	Per Cent.
Below 3.50 per cent, dangerously below the standard, . .	9
3.50 and 3.60 per cent, possibly below the standard, . . .	19
	28
3.70 and 3.80 per cent, on the line, ...	17
Above 3.80 per cent, undoubtedly above standard, . . .	55
	72

Two samples bought in the open market in a Massachusetts city tested 1.60 and 1.70; these were probably watered or skimmed, and are not included in the above.

The bureau has also made some investigations as to the accuracy of mathematical formulæ, published by the Vermont and Wisconsin experiment stations, for ascertaining the total solids in milk by the Babcock test and the specific gravity as shown by the lactometer.

One formula is: —

Total solids equal lactometer divided by 4 plus $1\frac{1}{5}$ fat.

The results have been very satisfactory, so far as we have been able to carry them.

The following is the result of six experiments made by chemist J. R. Blair, employed by the C. Brigham Company: —

	Specific Gravity.	Fat.	Total Solids by Analysis.	Total Solids by Calculation.
Sample No. 1, . . .	1.0317	2.60	11.24	11.04
Sample No. 2, . . .	1.0322	3.00	11.66	11.62
Sample No. 3, . . .	1.0317	2.90	11.60	11.50
Sample No. 4, . . .	1.0322	2.90	11.58	11.50
Sample No. 5, . . .	1.0322	2.90	11.52	11.50
Sample No. 6, . . .	1.0322	2.50	11.14	11.04

FINALLY.

It has been the aim of the bureau to carry out the instructions of the law in a broad spirit. We have endeavored in the time given us to do our best to enforce the criminal laws placed under our charge, and to carry out our public duties. But we have given equal attention to the broad educational field. We have endeavored to exert such an influence for better and purer dairy products as to remove from the laws any stigma of class legislation, and to place them upon the broad plane of valuable provisions for the welfare of the whole people. We believe that our work has been of some value in this direction. We know it has given us valuable experience which leads us to hope for better results as time goes on. The importance of our work can hardly be overestimated. To protect the agricultural interests, to check fraud and to enhance the quality of leading food products, is a labor as great as it is necessary and valuable.

The financial report of the dairy bureau is appended.

CALVIN L. HARTSHORN,
GEO. L. CLEMENCE,
D. A. HORTON,
State Dairy Bureau.

FINANCIAL REPORT OF THE DAIRY BUREAU.

Appropriation by Legislature of 1892,	$4,000 00	
C. L. Hartshorn, *Chairman :* —		
Travelling and necessary expenses,		$39 00
Eleven days' services,		55 00
G. L. Clemence : —		
Travelling and necessary expenses,		86 95
Twelve days' services,		60 00
D. A. Horton : —		
Travelling and necessary expenses,		42 00
Seven days' services,		35 00
G. M. Whitaker, *Assistant Executive Officer :* —		
Travelling and necessary expenses,		308 74
J. W. Stockwell, *Agent :* —		
Salary,		1,075 00
Travelling and necessary expenses,		619 96
James Cheesman, *Expert :* —		
Services,		80 00
Analyses and tests,		778 50
Printing,		70 86
Legal services and court attendance,		150 00
Supplies,		26 50
	$4,000 00	$3,427 51

FINANCIAL RETURNS

AND

ANALYSIS OF PREMIUMS AND GRATUITIES

OF THE

INCORPORATED SOCIETIES,

WITH

MEMBERSHIP AND INSTITUTES FOR THE YEAR

1892.

RETURNS OF SOCIETIES.

AMESBURY AND SALISBURY AGRICULTURAL AND HORTICULTURAL SOCIETY.

Incorporated 1881, Acts of 1881, chapter 204.

Originally raised by contribution $1,002.32; now has $6,610 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $6,735.28: real estate, $6,500; crockery, tables, etc., $1,100; bills due, $47.50; cash, $77.78. Total liabilities, $2,106.17: premiums unpaid, $40; outstanding bills, $166.17; mortgages or like liabilities, $1,900. Receipts in 1892, $3,046.73: bounty, $525.75; notes, $42; new members, $90; donations, $685.80; other sources, $1,703.18. Expenditures in 1892, $1,717.10: premiums and gratuities paid, $766.70; current running expenses, $95.25; interest, $3.75; other expenses, $851.40. The society offered $1,500 in premiums, awarded $806.70 in premiums and gratuities, and paid $766.70, which went to 14 cities and towns. Eighty-three dollars and sixty-five cents went to 4 towns outside the State. Two hundred and seventy-five persons received premiums and 237 gratuities. Under head of farms $16 was awarded and paid; under farm and pet stock $289.75 was awarded and $280.75 paid; under field and experimental crops $5 was awarded and paid; under farm and garden products $170.10 was awarded and $164.10 paid; under dairy products $3.25 was awarded and paid; under domestic manufactures $169.15 was awarded and $151 paid; under agricultural implements $7 was awarded and paid; under objects strictly agricultural, not specified, $19 was awarded and $13 paid; under objects other than agricultural, $127.45 was awarded and $126.60 paid. The society reports 161 members, —148 males and 13 females. Three farmers' institutes were held at Amesbury: January 5, on "Poultry for profit" and "A trip through the Rockies;" January 26, on "Dairying" and "Unequal taxation;" February 23, on "How to make our farms and gardens more profitable" and "The laws of competition as affecting the Massachusetts farmer."

ATTLEBOROUGH AGRICULTURAL ASSOCIATION.

Incorporated 1887, Acts of 1887, chapter 203.

Originally raised by contribution $20,000, which is now invested as a capital stock in land, buildings, furniture, fixtures, etc. Total assets, $25,076.77: real estate, $24,500; crockery, tables, etc., $500; cash, $76.77. Total liabilities, $6,574.90: premiums unpaid, $74.90; note, $6,500. Receipts in 1892, $10,787.97: bounty, $600; new members, $425; donations, $28; other sources, $9,734.97. Expenditures in 1892, $10,711.30: premiums and gratuities paid, $1,247.40; current running expenses, $350; interest, $792.79; other expenses, $8,321.11. The association offered $2,573.45 in premiums, awarded in premiums and gratuities $1,322.30, and paid $1,247 40, which went to 19 cities and towns. Of this amount, $153.45 went to 5 cities and towns outside the State. One hundred and fifty-eight persons received premiums and 35 received gratuities. Under head of farms $10 was awarded and paid; under farm and pet stock $318.75 was awarded and $276.75 paid; under farm and garden products $197.75 was awarded and $176.65 paid; under dairy products $6 was awarded and paid; under domestic manufactures $98.80 was awarded and $87 paid, for firemen's contest $100 was awarded and paid *; under trotting $625 was awarded and paid; under objects other than agricultural, not specified, $66 was awarded and paid. The association reports 106 members, — 98 males and 8 females. Three farmers' institutes were held: at Franklin, March 16, on "Corn culture" and "Equitable taxation in Massachusetts;" at Attleborough, March 24, on "Milk and its production" and "The importance of agriculture;" at North Attleborough, November 16, on "Poultry raising,— methods and breeds for the farmer," "Observations in California" and "The relations of city and country life."

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* Not included in amount of premiums and gratuities paid.

BARNSTABLE COUNTY AGRICULTURAL SOCIETY.

Incorporated 1844, Acts of 1844, chapter 114.

The society in its first report to the Board in 1853 reported the amount of its permanent fund (par value) to b $1,740; now has $8,300 invested as a capital stock in real estate and bonds. Total assets, $8,300.43: real estate, $7,500; bonds, $800; cash, $0.43. Total liabilities, $2,613.05: outstanding bills, $113.05; note, $2,500. Receipts in 1892, $3,183.85: bounty, $600; bonds, $38; new members, $50; donations, $5; other sources, $2,490.85. Expenditures in 1892, $3,183.42: premiums and gratuities paid, $1,341.20; current running expenses, $911.98; interest, $156.25; other expenses, $773.99. The society offered $1,374.90 in premiums, and awarded and paid $1,341.20 in premiums and gratuities, which went to 14 cities and towns. Two hundred and twenty-nine persons received premiums and gratuities. Under head of farms $18 was awarded and paid; under farm and pet stock $611.25 was awarded and paid; under field and experimental crops $49 was awarded and paid; under farm and garden products $140.30 was awarded and paid; under dairy products $11.50 was awarded and paid; under domestic manufactures $90.65 was awarded and paid; under trotting $400 was awarded and paid. The society reports 605 members, — 365 males and 240 females. Three farmers' institutes were held: at Barnstable, July 26, on "What ways shall be devised for improving the highways of Barnstable County?" at Barnstable, September 15, on "What means shall be devised for improving the financial standing of the society?" at West Barnstable, December 22, on "The best soiling crops to raise on Cape Cod."

BAY STATE AGRICULTURAL SOCIETY.

Incorporated 1886, General Laws.

The society in its first report (1888) stated the amount raised by contribution to be at that time $2,177.16; now has $343.48 invested as a capital stock in cash. Receipts in 1892, $310: new members, $10; other sources, $300.

Expenditures in 1892, $254.92: current running expenses, $5.82; other expenses, $249.10. The society held no fair in 1892. The society reports a membership of 440. Three farmers' institutes were held: at Boston (union with Massachusetts Horticultural Society), February 6, on "The construction of country roads;" at Salem (union with Essex Agricultural Society), February 19, on "What the United States government is doing to perpetuate the salt-water fishes;" at Boston (union with Massachusetts Horticultural Society), February 20, on "Fruits to preserve, and how to preserve them." The society also held two dairy schools and two cooking schools.

BERKSHIRE AGRICULTURAL SOCIETY.

Incorporated 1811, Acts of 1811, chapter 70.

The society in its first report to the Board in 1853 reported the amount of its permanent fund (par value) to be $3,000; now has $15,000 invested as a capital stock in real estate. Total assets, $15,387.87: real estate, $15,000; bills due, $75; cash, $312.87. Total liabilities, $8,261.75: premiums unpaid, $76.50; outstanding bills, $65.25; mortgages or like liabilities, $8,120. Receipts in 1892, $7,159.32: bounty, $600; donations, $169; other sources, $6,390.32. Expenditures in 1892, $7,206.98: premiums paid, $3,133.25; current running expenses, $2,819.09; interest, $480; other expenses, $774.64. The society offered $4,688.50 in premiums, awarded $3,209.75 and paid $3,133.25, which went to 24 cities and towns. Thirty-one dollars and fifty cents was awarded to parties outside the State. Three hundred and twenty-two persons received premiums, exclusive of those receiving purses for trotting. Under head of farm and pet stock $764 was awarded and paid; under farm and garden products $427.50 was awarded and paid; under dairy products $30 was awarded and paid; under domestic manufactures $251.25 was awarded and paid; under agricultural implements $61 was awarded and paid; under objects strictly agricultural, not specified, $5 was awarded and paid; under trotting $1,561.50 was awarded and paid; under objects other than agricultural, not specified, $66 was awarded and paid. The society reports 1,194 members, —

1,089 males and 105 females. Three farmers' institutes were held: at Cheshire, November 18, a dairy school by the State Dairy Bureau; at Pittsfield, November 19, on "The qualities of milk;" at Hinsdale, November 25, on "Does farming pay as well now as thirty years ago?" and "Improvement of roads."

BLACKSTONE VALLEY AGRICULTURAL SOCIETY.

Incorporated 1884, Acts of 1884, chapter 48.

Originally raised by contribution $3,000; now has $3,100 invested as a capital stock in real estate, crockery, etc. Total assets, $3,468.97: real estate, $3,000; bank funds, $368.97; crockery, tables, etc., $100. Receipts in 1892, $1,835.41; bounty, $600; new members, $53; donations, $33.60; other sources, $1,148.81. Expenditures in 1892, $2,016.58; premiums and gratuities paid, $925.05; current running expenses, $1,091.53. The society offered in premiums $925.05, and awarded and paid $925.05, which went to 18 cities and towns. Thirty-seven dollars went to 4 cities and towns outside the State. One hundred and eight persons received premiums and 74 gratuities. Under head of farms $104 was awarded and paid; under farm and pet stock $607 was awarded and paid; under field and experimental crops $45 was awarded and paid; under farm and garden products $76.25 was awarded and paid; under dairy stock $10 was awarded and paid; under domestic manufactures $58.25 was awarded and paid; for objects other than agricultural, $72.25 was awarded and paid. The society reports 473 members, — 261 males and 212 females. Three farmers' institutes were held: at Uxbridge, March 2, on "Stock raising;" at Uxbridge, March 9, on "Poultry raising;" at Mendon, April 13, on "Corn: its value for grain and its use in the silo."

BRISTOL COUNTY AGRICULTURAL SOCIETY.

Incorporated 1823, Acts of 1823, chapter 32.

The society in its first report to the Board in 1853 reported the amount of its permanent fund (par value) to be $3,240; now has $30,000 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $30,964: real estate, $29,800; crockery, tables, etc., $200; cash, $964. Total liabilities, $14,044.10: premiums unpaid, $44.10; mortgages or like liabilities, $14,000. Receipts in 1892, $15,151.74: bounty, $600; new members, $110; other sources, $14,441.74. Expenditures in 1892, $16,245.33: premiums and gratuities paid, $3,998.92; current running expenses, $6,194.41; interest, $1,067; other expenses, $4,985. The society offered $4,460 in premiums; awarded $3,797.67 in premiums and gratuities; and paid $3,753.57, which went to 34 cities and towns. Two hundred and ninety-two dollars and thirty-five cents went to 5 cities and towns outside the State. Eight hundred and forty-nine persons received premiums and 58 gratuities. Under head of farms $216 was awarded and paid; under farm and pet stock $1,260 was awarded and paid; under field and experimental crops $53 was awarded and paid; under farm and garden products $223.50 was awarded and $203.50 paid; under dairy products $51 was awarded and $47 paid; under domestic manufactures $246.27 was awarded and $234.17 paid; under objects strictly agricultural, not specified, $175 was awarded and $167 paid; under trotting $1,260 was awarded and paid; under objects other than agricultural, not specified, $239 was awarded and paid. The society reports 852 members, — 668 males and 184 females. Three farmers' institutes were held: at Dighton, February 17, on "Small fruits;" at Taunton, March 16, on "Application of fertilizers" and "How to get the best potato crop;" at New Bedford, March 18, on "Care and management of milch cows" and "The work of the State Dairy Bureau."

DEERFIELD VALLEY AGRICULTURAL SOCIETY.

Incorporated 1871, Acts of 1871, chapter 208.

Originally raised by contribution $4,094.01; now has $9,000 invested as a capital stock in real estate. Total assets, $9,202.15: real estate, $9,000; crockery, tables, etc., $150; cash, $52.15. Total liabilities consist of a note for $1,075. Receipts in 1892, $4,984.92: bounty, $600; bank funds, $1,814.15; new members, $141; donations, $4.25; other sources, $2,425.32. Expenditures in 1892, $4,984.92: premiums paid, $878.15; current running expenses, $1,536.77; other expenses, $2,570. The society offered $1,042.25 in premiums; awarded and paid in premiums $878.15, which went to 28 cities and towns. Eight dollars and twenty-five cents went to 4 towns outside the State. Two hundred persons received premiums. Under head of farm and pet stock $571.80 was awarded and paid; under farm and garden products $67.50 was awarded and paid; under dairy products $10 was awarded and paid; under domestic manufactures $84.35 was awarded and paid; under trotting $100 was awarded and paid; under objects other than agricultural, not specified, $44.50 was awarded and paid. The society reports 1,300 members, — 1,202 males and 98 females. Three farmers' institutes were held: at Charlemont, January 30, on "Obstacles to successful farming, and how to overcome them;" at Buckland, February 10, on "Dairy stock: its care and management;" at Ashfield, February 17, on "Home-made and manufactured fertilizers" and "Our Alaskan farm."

EASTERN HAMPDEN AGRICULTURAL SOCIETY.

Incorporated 1856, Acts of 1856, chapter 156.

Originally raised by contribution $3,000; now has $7,000 invested as a capital stock in real estate. Total assets, $7,069.89: real estate, $7,000; cash, $69.89. Total liabilities consist of a note for $2,380. Receipts in 1892, $2,433.49: bounty, $600; new members, $26; donations, $43.61; other sources, $1,763.88. Expenditures in 1892, $2,363.60: premiums and gratuities paid, $1,562.60; current running expenses, $680.78; interest, $120.22; other expenses, $165. The society offered in premiums $1,635.10, and awarded and paid $1,562.60 in premiums and gratuities, which went to 26 cities and towns. Three hundred and forty-eight dollars and thirty-eight cents went to 5 cities and towns outside the State. One hundred and fourteen persons received premiums and gratuities. Under head of farm and pet stock $343.50 was awarded and paid; under farm and garden products $69.50 was awarded and paid; under dairy products $6 was awarded and paid; under domestic manufactures $39.10 was awarded and paid; under trotting $1,087 was awarded and paid; under objects other than agricultural, not specified, $17.50 was awarded and paid. The society reports 460 members, — 259 males and 201 females. Four farmers' institutes were held at Palmer: January 14, on "Abandoned farms" and "Taxation;" February 9, on "Small fruits and asparagus;" March 1, on "Have agricultural colleges been a benefit to the average farmer?" and "Legislation affecting the farmer;" March 29, on "Highways" and "Fertilizers."

ESSEX AGRICULTURAL SOCIETY.

Incorporated 1818, Acts of 1818, chapter 25.

The society in its first report to the Board in 1853 reported the amount of its permanent fund (par value) to be $9,363.66, and now has $21,265.84 invested as a capital stock in real estate, stocks, bonds, bank funds, crockery, tables, etc. Total assets, $19,598.89: real estate, $5,000; stocks, $13,333.05; bonds, $1,000; bank funds, $65.84; crockery, tables, etc., $200. Receipts in 1892, $2,785.76: bounty, $600; stocks, $969.68; bonds, $60; new members, $234; other sources, $922.08. Expenditures in 1892, $2,777.73: premiums paid, $1,858.25; current running expenses, $919.48. The society offered in premiums $3,697, awarded $1,983.25* and paid $1,858.25,* which went to 27 cities and towns, and to 395 persons. Under head of farms $144 was awarded and $143 paid; under farm and pet stock $868 was awarded and $730 paid; under field and experimental crops $140 was awarded and $70 paid; under farm and garden products $466.75 was awarded and $467 paid; under dairy products $28 was awarded and $14 paid; under domestic manufactures $158.75 was awarded and $158.25 paid; under agricultural implements $42 was awarded and $45 paid; under objects strictly agricultural, not specified, $153 was awarded and paid; under objects other than agricultural, $81 was awarded and $91.50 paid. The society reports 1,516 members, —1,498 males and 18 females. Seven farmers' institutes were held: at Newbury, January 15, on "Management of milch cows" and "What benefits do the farmers derive from the State Board of Agriculture?" at Methuen, February 5, on "Economical production of milk" and "Usefulness of Boards of Agriculture;" at Salem, February 19, on "What the national government is doing to perpetuate the salt-sea fishes" and "Fish as a fertilizer;" at Beverly, February 26, on "Sheep husbandry" and "Laws of Competition as affecting the Massachusetts farmer;" at North Andover, March 4, on "Fruits: the best varieties and the best methods of cultivation" and "Vegetables and how to raise them;" at Marblehead, March 25, on "The utilization for plant food of the wastes of the ocean, both animal and vegetable" and "The judicious use of manures;" at Danvers, April 19, a field institute.

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* Amounts paid for 1891; awarded for 1892.

FRANKLIN COUNTY AGRICULTURAL SOCIETY.

Incorporated 1850, Acts of 1850, chapter 104.

The society in its first report to the Board in 1853 stated the amount of its permanent fund (par value) to be $3,768; now has $7,020 invested as a capital stock in real estate and bank stock. Total assets, $7,712.09: real estate, $6,000; stocks, $1,020; bank funds, $608.09; bills due and unpaid, $4. Total liabilities, premiums unpaid, $39. Receipts in 1892, $2,816.64: bounty, $600; stocks, $60.81; bank funds, $16.06; new members, $120; other sources, $2,019,77. Expenditures in 1892, $2,637.66: premiums and gratuities paid, $996.15*; current running expenses, $1,641.51. The society offered in premiums $1,330, awarded $1,025.15 in premiums and gratuities, and paid $986.15, which went to 16 towns. Two hundred and sixty-four persons received premiums and 2 gratuities. Under head of farms $12 was awarded and $8 paid; under farm and pet stock $691.50 was awarded and $664.50 paid; under farm and garden products $161 was awarded and $158 paid; under dairy products $13 was awarded and paid; under domestic manufactures $125.65 was awarded and $121.65 paid; under trotting $500 was awarded and paid; under objects other than agricultural, not specified, $22 was awarded and $21 paid. Diplomas were awarded for agricultural implements. The society reports about 1,800 members, — 1,500 males and 300 females. Three farmers' institutes were held: at Greenfield, January 16, on "Botany of the farm" and "The five secrets of good butter-making;" at Montague, February 6, on "The Dairy Bureau" and "Country roads;" at Greenfield, February 15, on "Fair management."

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* $10 for 1891.

HAMPDEN AGRICULTURAL SOCIETY.

Incorporated 1844, Acts of 1844, chapter 56.

The society in its first report to the Board in 1853 stated the amount of its permanent fund (par value) to be $4,860; now has $794.79 invested as a capital stock in bank funds and cash. Total assets, $794.79: bank funds, $580.67; cash, $214.12. Receipts in 1892, $1,904.77: bounty, $600; bank funds, $21.18; new members, $22.50; donations, $206.95; other sources, $1,054.14. Expenditures in 1892, $2,535.05: premiums and gratuities paid, $687.47; current running expenses, $1,001.69; other expenses, $845.89. The society offered in premiums $2,075, awarded $892.45 in premiums and gratuities, and paid $687.47, which went to 14 cities and towns. Eighty-three persons received premiums and 25 received gratuities. Under head of farm and pet stock $384.25 was awarded and $329.01 paid; under field and experimental crops $63.25 was awarded and paid; under farm and garden products $108.95 was awarded and $102.33 paid; under dairy products $6 was awarded and paid; under domestic manufactures $118.75 was awarded and $99.63 paid; under agricultural implements $32 was awarded and paid; under other objects strictly agricultural, not specified, $28.50

was awarded and paid; under trotting $495 was awarded and paid; under objects other than agricultural, not specified, $38.75 was awarded and $26.75 paid. The society reports 965 members, — 782 males and 183 females. Four farmers' institutes were held: at Springfield, January 28, on "Feeding milch cows;" at Ludlow, February 17, on "Improvement of our farms and homes" and "The judicious use of manures and fertilizers;" at Westfield, March 9, on "Flowers: their propagation and culture" and "Breeding and care of horses;" at Holyoke, March 30, on "The judicious use of manures and fertilizers."

HAMPSHIRE AGRICULTURAL SOCIETY.

Incorporated 1814, Acts of 1814, chapter 19.

The society in its first report to the Board in 1853 stated the amount of its permanent fund (par value) to be $3,255.26; now has $2,650 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $2,680.51: real estate, $2,500; crockery, tables, etc., $150; bills due, $30; cash, $0.51. Total liabilities, $795: outstanding bills, $45; mortgages or like liabilities, $750. Receipts in 1892, $1,989.76: bounty, $600; new members, $80; donations, $122; other sources, $1,187.76. Expenditures in 1892, $1,989.76: premiums and gratuities paid, $640.90; current running expenses, $768.51; interest, $45.35; other expenses, $535. The society offered in premiums $924, and awarded and paid $640.90 in premiums and gratuities, which went to 16 cities and towns. One hundred and six persons received premiums and 6 gratuities. Under head of farm and pet stock $352 was awarded and paid; under field and experimental crops $18 was awarded and paid; under farm and garden products $122 was awarded and paid; under dairy products $8 was awarded and paid; under domestic manufactures $29.92 was awarded and paid; under objects strictly agricultural, not specified, $49 was awarded and paid; under trotting $288 was awarded and paid. The society reports 772 members, — 541 males and 231 females. Three farmers' institutes were held: at Hadley, January 29, on "Scientific stock rations" and "Dairy products;" at Amherst, February 26, on "Fruits;" at Amherst, March 11, on "Judicious use of fertilizers" and "Obstacles to successful farming, and how to overcome them."

HAMPSHIRE, FRANKLIN AND HAMPDEN AGRICULTURAL SOCIETY.

Incorporated 1818, Acts of 1818, chapter 125.

The society in its first report to the Board in 1853 stated the amount of its permanent fund (par value) to be $8,141.29; now has $1,877.20 invested as a capital stock in personal property. Total assets, $1,877.20: lease, $1,600; crockery, tables, etc., $150; bills due, $45; cash, $82.20. Total liabilities, $665.36: outstanding bills, $60; note and interest, $605.36. Receipts in 1892, $5,983.71: bounty, $600; bank funds, $83; other sources, $5,305.71. Expenditures in 1892, $5,901.51: premiums paid, $686.72; current running expenses, $783.35; interest, $4.22; other expenses, $4,427.22. The society offered $1,179.50 in premiums, awarded $781.25, and paid $686.72, which went to 15 cities and towns. Two hundred and eighty persons received premiums. Under head of farm and pet stock $501 was awarded and $451.50 paid; under field and experimental crops $9 was awarded and paid; under farm and garden products $140.25 was awarded and $119.62 paid; under domestic manufactures $140 was awarded and $108.50 paid; under agricultural implements $24 was awarded and paid; under trotting $577.50 was awarded and paid; under objects other than agricultural, not specified, $172.50 was awarded and paid. The society reports 800 members,—650 males and 150 females. Three farmers' institutes were held: at Northampton, January 6, on "Farming in Alaska;" at Hadley, January 29, on "Work of the Dairy Bureau" and "Feeding cows and stock;" at Southampton, February 12, on "Obstacles to successful farming, and how to overcome them."

HIGHLAND AGRICULTURAL SOCIETY.

Incorporated 1859, Acts of 1859, chapter 145.

Originally raised by contribution $3,262; now has $1,100 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $1,246.52: real estate, $1,000; crockery, tables, etc., $100; cash, $146.52. Receipts in 1892, $1,733.67: bounty, $600; new members, $21; donations, $4; other sources, $1,108.67. Expenditures in 1892, $1,587.15: premiums and gratuities paid, $584.15; current running expenses, $999.92; interest, $3.08. The society offered in premiums $761.05; awarded and paid $584.15 in premiums and gratuities, which went to 17 cities and towns. One dollar and seventy cents went to one city outside the State. One hundred and fifty persons received premiums and 6 gratuities. Under head of farm and pet stock $380.50 was awarded and paid; under field and experimental crops $37 was awarded and paid; under farm and garden products $30.65 was awarded and paid; under dairy products $9.50 was awarded and paid; under domestic manufactures $60.70 was awarded and paid; under agricultural implements $9.50 was awarded and paid; under trotting $27 was awarded and paid; under objects other than agricultural, not specified, $29.30 was awarded and paid. The society reports 456 members, — 323 males and 133 females. Three farmers' institutes were held: at Hinsdale, April 5, on "Work of the Dairy Bureau;" at Middlefield, September 7, on "Needs of farmers;" at Becket, December 20, on "Road making and repairing."

HILLSIDE AGRICULTURAL SOCIETY.

Incorporated 1883, Acts of 1883, chapter 112.

Originally raised by contribution $3,113.32; now has $4,792.72 invested as a capital stock in real estate, cash, crockery, tables, etc. Total assets, $4,792.72: real estate, $4,124.53; crockery, tables, etc., $315.82; bills due, $3; cash, $349.37. Total liabilities consist of premiums unpaid, $24.75. Receipts in 1892, $1,639.87: bounty, $600;

new members, $172; donations, $7.62; other sources, $858.25. Expenditures in 1892, $1,265.75: premiums paid, $678.90; current running expenses, $442.99; other expenses, $143.86. The society offered in premiums $750, awarded $703.65, and paid $678.90, which went to 26 cities and towns. Three dollars went to 3 cities and towns outside the State. Three hundred and five persons received premiums. Under head of farms $7.50 was awarded and paid; under farm and pet stock $444.05 was awarded and $428.45 paid; under field and experimental crops $44.50 was awarded and paid; under farm and garden products $79.80 was awarded and $75.60 paid; under dairy products $15.50 was awarded and paid; under domestic manufactures $83.30 was awarded and $79.35 paid; under agricultural implements $4.50 was awarded and paid; under objects strictly agricultural, not specified, $4 was awarded and paid; under objects other than agricultural $21 was awarded and $19.50 paid. The society reports 565 members, — 543 males and 22 females. Six farmers' institutes were held: at Goshen, January 6, on "Fertilizers" and "The results of some experiments at the Agricultural College farm;" at West Chesterfield, February 13, on "Co-operative creameries;" at Ashfield, February 17, on "Fertilizers" and "Our Alaskan farm;" at Cummington, March 18, on "Fertilizers," "Brain food for farmers' boys" and "Our country: its phenomenal growth and present magnitude;" at Cummington, August 24, on "General subjects;" at Cummington, September 27, on "The Creamery," "What the State Board is doing for agriculture" and "The silo."

HINGHAM AGRICULTURAL AND HORTICULTURAL SOCIETY.

Incorporated 1867, Acts of 1867, chapter 99.

Originally raised by contribution $17,406,15; now has $22,000 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $22,284.50: real estate, $20,000; crockery, tables, etc., $2,000; cash, $284.50. Total liabilities consist of mortgages or like liabilities to the amount of $1,050. Receipts in 1892, $3,417.31: bounty, $600; new members, $257; donations, $199.10; other sources, $2,361.21. Expenditures in 1892, $3,405.86: premiums and gratuities paid, $602; current running expenses, $1,646.56; interest and notes paid, $879.58; other expenses, $277.72. The society offered in premiums $1,928.40, and awarded and paid $602 in premiums and gratuities, which went to 13 cities and towns. One hundred and twenty-three persons received premiums and 279 gratuities. Under head of farm and pet stock $352 was awarded and paid; under farm and garden products $125.10 was awarded and paid; under dairy products $7.50 was awarded and paid; under domestic manufactures $65.95 was awarded and paid; under objects other than agricultural $51.45 was awarded and paid. The society reports 741 members, — 524 males and 217 females. Five farmers' institutes were held at Hingham: January 11, on "A trip to the farms and fruit orchards of California and the far West;" April 11, on "Taxation;" May 9, on "The labor question;" June 6, on "Roses;" August 8, on "Farming in Early England."

HOOSAC VALLEY AGRICULTURAL SOCIETY.

Incorporated 1860, Acts of 1860, chapter 56.

Originally raised by contribution $2,006; now has $13,350 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $13,434.44: real estate, $12,900; crockery, tables, etc., $450; bills due, $41.63; cash, $42.81. Total liabilities, $574.06: outstanding bills, $74.06; note, $500. Receipts in 1892, $7,912.99: bounty, $600; from notes, $13.86; new members, $120; donations, $100; other sources, $7,079.13. Expenditures in 1892, $7,620.08: premiums paid, $2,667.58; current running expenses, $2,741.74; interest, $8.80; other expenses, $2,201.96. The society offered in premiums, $3,883.50; awarded and paid $2,667.58, which went to 18 cities and towns. One hundred and seven dollars went to 5 cities and towns outside the State. Two hundred and thirty-one persons received premiums. Under head of farms $61 was awarded and paid;

under farm and pet stock $551 was awarded and paid; under field and experimental crops $190 was awarded and paid; under farm and garden crops $126.50 was awarded and paid; under dairy products $31 was awarded and paid; under domestic manufactures $179 was awarded and paid; under agricultural implements $20 was awarded and paid; under trotting $1,746 was awarded and paid; under objects other than agricultural, not specified, $85.50 was awarded and paid. The society reports 947 members, — 932 males and 15 females. Three farmers' institutes were held: at Cheshire, December 10, on "Sheep and sheep raising and management;" at North Adams, December 17, on "Feeding of stock;" at Williamstown, December 24, on "Dairy cows" and "Roads."

HOUSATONIC AGRICULTURAL SOCIETY.

Incorporated 1848, Acts of 1848, chapter 101.

The society in its first report to the Board in 1853 reported the amount of its permanent fund (par value) to be $6,335.33; now has $12,661.04 invested as a capital stock in real estate, stocks and bank funds. Total assets, $13,049.61: real estate, $11,000; stocks, $1,000; bank funds, $661.04; crockery, tables, etc., $200; cash, $188.57. Total liabilities, $550: outstanding bills, $250 (estimated); mortgages or like liabilities, $300. Receipts in 1892, $9,262.43: bounty, $600; from stocks, $52.75; from bank funds, $23.71; new members, $188.67; other sources, $8,397.30. Expenditures in 1892, $9,048.26: premiums paid, $2,786.86; current running expenses, $2,535.97; interest, $26.88; other expenses, $3,698.55. The society offered in premiums $2,342, awarded $2,798.36, and paid $2,786.86, which went to 24 cities and towns. Five dollars went to two towns outside the State. Four hundred and twenty persons received premiums. Under head of farms $25 was awarded and paid; under farm and pet stock $951 was awarded and $950 paid; under field and experimental crops $259 was awarded and $253 paid; under farm and garden crops $270.50 was awarded and $269 paid; under dairy products $33 was awarded and paid; under domestic manufactures $412 was awarded and $408.50 paid;

under trotting $780 was awarded and paid; under objects other than agricultural, not specified, $92.86 was awarded and paid. The society reports 1,535 members, — 1,488 males and 47 females. Three farmers' institutes were held at Great Barrington: February 17, on "Ayrshire cows for the dairy," "Corn for ensilage" and "Horse breeding;" March 2, on "The destruction of insects injurious to fruit trees" and "Is fall ploughing advisable for raising summer crops?" March 31, on "Fruit trees, the diseases of, and insects injuring."

MARSHFIELD AGRICULTURAL AND HORTICULTURAL SOCIETY.

Incorporated 1867, Acts of 1867, chapter 116.

Originally raised by contribution $3,755.43; now has $20,580.08 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $20,580.08: real estate, $19,072.78; crockery, tables, etc., $1,507.30. Total liabilities, $5,212.30: premiums unpaid, $212.30; mortgages or like liabilities, $5,000. Receipts in 1892, $3,463.93: bounty, $600; new members, $50; other sources, $2,813.93. Expenditures in 1892, $3,154.44: premiums and gratuities paid, $1,328.12; current running expenses, $1,486.32; interest, $340. The society offered in premiums $1,643, awarded in premiums and gratuities $1,540.42, and paid $1,328.12, which went to 30 cities and towns. One dollar and eighty-seven cents went to one city and one town outside the State. Sixty-three persons received premiums and 263 gratuities. Under head of farm and pet stock $344.10 was awarded and paid; under field and experimental crops $4 was awarded and paid; under farm and garden products $164.05 was awarded and paid; under dairy products $24 was awarded and paid; under domestic manufactures $124.97 was awarded and paid; under trotting $667 was awarded and paid; under objects other than agricultural, not specified, $24.48 was awarded and paid. The society reports 867 members, — 562 males and 305 females. Three farmers' institutes were held at Marshfield: January 7, on "Raising of Indian corn" and "Work of the Weather Bureau;" February 9, on "Small fruits for family use" and "How fertilizers can be profitably used in farming;" March 16, on "Farming," "Grass culture" and "Raising of seeds and vegetables."

MARTHA'S VINEYARD AGRICULTURAL SOCIETY.

Incorporated 1859, Acts of 1859, chapter 33.

Originally raised by contribution $4,552.17; now has $4,171.25 invested as a capital stock in real estate, notes, bank funds, crockery, tables, etc. Total assets, $4,244.29: real estate, $2,500; notes, $700; bank funds, $771.25; crockery, tables, etc., $200; cash, $73.04. Receipts in 1892, $1.175.84: bounty, $600; from notes, $57.83; bank funds, $26.06; new members, $10; donations, $2.05; other sources, $479.90. Expenditures in 1892, $1,023.79: premiums and gratuities paid, $605.88; current running expenses, $302.79; other expenses, $115.12. The society offered $775 in premiums, and awarded and paid $605.88 in premiums and gratuities, which went to 5 towns. Forty-nine persons received premiums and 141 gratuities. Under head of farms $3 was awarded and paid; under farm and pet stock $201.25 was awarded and paid; under field and experimental crops $56 was awarded and paid; under farm and garden products $122.74 was awarded and paid; under dairy products $17.05 was awarded and paid; under domestic manufactures $132 was awarded and paid; under objects other than agricultural $75.84 was awarded and paid. The society reports 224 members, — 136 males and 88 females. Three farmers' institutes were held at West Tisbury: May 25, on "Strawberry culture;" October 6, on "Sheep husbandry;" November 30, on "Progress in farming."

MASSACHUSETTS SOCIETY FOR PROMOTING AGRICULTURE.

Incorporated 1792, Acts of 1792, chapter 33.

This society holds no annual fair or institutes. It has an annual income from invested funds, which is used in various ways for the promotion of agriculture.

MASSACHUSETTS HORTICULTURAL SOCIETY.

Incorporated 1829, Acts of 1829, chapter 22.

The first investment was from surplus Jan. 16, 1835, and amounted to $525. The society now has $247,000 invested as a capital stock in real estate, fixtures, bonds and library. Total assets, $314,359.30: real estate, $250,000; bonds, $13,480; crockery, tables, etc., $38,102.70; bills unpaid, $359.11; cash, $12,417.19. Total liabilities, $1,105: premiums unpaid, $105; mortgages or like liabilities, $1,000. Receipts in 1892, $33,329.33: bounty, $600; from bonds, $205; from bank funds, $326.45; new members, $760; other sources, $31,437.88. Expenditures in 1892, $24,163.27: premiums and gratuities paid, $6,249.10; current running expenses, $17,876.67; interest, $37.50. The society offered in premiums $6,800, awarded $6,354.10 in premiums and gratuities, and paid $6,249.10, which went to 62 cities and towns. One hundred and thirty-eight dollars and thirteen cents went to 6 cities and towns outside the State. One hundred and ninety-three* persons received premiums and 121* gratuities. Under head of farms $290 was awarded and $825† paid; under farm and garden products $6,873.75 was awarded and $6,653.10† paid. The society reports 783 members, — 736 males and 47 females. Twelve farmers' institutes were held at Horticultural Hall, Boston: January 9, on "Soil and irrigation of Egypt;" January 16, on "The new orcharding;" January 23, on "Late experience in dealing with insects injurious to fruit;" January 30, on "Irrigation with fresh sewage;" February 6, on "Road making and maintenance;" February 13, on "Fungous diseases and their remedies;" February 20, on "A talk about the preserving of fruit;" February 27, on "Arbor Day in schools;" March 5, on "Some considerations upon the subject of heat;" March 12, on "The Library of the Society;" March 19, on "The ethics of the flowers;" March 26, on "Relation of the work of the Weather Bureau to agriculture."

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* Except window gardeners.

† For 1891.

MIDDLESEX AGRICULTURAL SOCIETY.

Incorporated as The Western Society of Middlesex Husbandmen in 1803, Special Laws, Vol. III.; name changed to The Society of Middlesex Husbandmen and Manufacturers, 1819, Acts of 1819, chapter 73: name changed to Middlesex Agricultural Society, 1852, Acts of 1852, chapter 30.

The society in its first report to the Board in 1853 reported its permanent fund (par value) to be $3,000; now has no capital stock. No fair was held in 1892. The society reports 959 members,— 658 males and 301 females. Three farmers' institutes were held: at Stow, January 29, on "Feeding stock and the contagious diseases of stock;" at Hudson, March 4, on "Orchards and fertilizers;" at Bedford, March 16, on "Fertilizers and manures" and "Care and management of farm stock."

MIDDLESEX NORTH AGRICULTURAL SOCIETY.

Incorporated 1855, Acts of 1855, chapter 315.

Originally raised by contribution $3,000; now has $28,000 invested as a capital stock in real estate. Total assets, $29,000: real estate, $28,000; crockery, tables, etc., $400; cash, $600. Total liabilities, $5,000: premiums unpaid, $75; outstanding bills, $925; mortgages or like liabilities, $4,000. Receipts in 1892, $5,260.60: bounty, $600; new members, $125; other sources, $4,535.60. Expenditures in 1892, $3,465.17: premiums and gratuities paid, $1,175; current running expenses, $1,365.27; interest, $175; other expenses, $749.90. The society offered in premiums, $1,493, awarded $830.42 in premiums and gratuities, and paid $1,175, which went to 15 cities and towns. Two hundred and five persons received premiums and 149 gratuities. Under head of farm and pet stock $406 was awarded and $353 paid; under field and experimental crops $42 was awarded and $38.50 paid; under farm and garden products $255.50 was awarded and $231.50 paid; under dairy products $8 was awarded and paid; under domestic manufactures $121.25 was awarded and $102.75 paid; under trotting $334.50 was awarded and paid. The society reports 809 members,— 624 males and 185 females. Three farmers' institutes were held: at Chelmsford, February 6, on "Obstacles to successful farming, and how to overcome them" and "Best methods in the care and cultivation of apple orchards;" at Tewksbury, March 23, on "Market gardening under glass and in the field;" at Dracut, November 10, on "Poultry" and "Fruit culture."

MIDDLESEX SOUTH AGRICULTURAL SOCIETY.

Incorporated 1854, Acts of 1854, chapter 84.

Originally raised by contribution $3,000; now has $15,200 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $15,265.10: real estate, $15,000; crockery, tables, etc., $200; cash, $65.10. Total liabilities consist of mortgages or like liabilities to the amount of $7,300. Receipts in 1892, $2,490.50: bounty, $600; new members, $78; donations, $50.70; other sources, $2,361.80. Expenditures in 1892, $2,425.40: premiums and gratuities paid, $882.09; current running expenses, $430.73; interest, $389.05; other expenses, $723.53. The society offered $1,362.44 in premiums, and awarded and paid $882.09 in premiums and gratuities, which went to 7 towns. One hundred and twenty-six persons received premiums and 28 gratuities. Under head of farms $18 was awarded and paid; under farm and pet stock $182.50 was awarded and paid; under field and experimental crops $82 was awarded and paid; under farm and garden products $111.05 was awarded and paid; under domestic manufactures $45.45 was awarded and paid; under trotting $278.25 was awarded and paid; under objects other than agricultural, not specified, $13.75 was awarded and paid. Diploma given for agricultural implements. The society reports 545 members, — 356 males and 189 females. Three farmers' institutes were held: at Framingham, February 10, and at Sherborn, February 17, on "Obstacles to successful farming in Massachusetts, and how to overcome them;" at Framingham, December 28, on "Holstein stock" and "Moonshine in farming."

NANTUCKET AGRICULTURAL SOCIETY.

Incorporated 1856, Acts of 1856, chapter 25.

Originally raised by contribution $3,500; now has $3,200 invested as a capital stock in real estate. Total assets, $3,277.82: real estate, $3,200; cash, $77.82. Total liabilities, premiums unpaid, $4.50. Receipts in 1892, $1,349.27: bounty, $600; new members, $26; donations, $6.33; other sources, $716.94. Expenditures in 1892 consist of $604.25 in premiums and gratuities paid. The society offered in premiums $1,214, awarded $608.75 in premiums and gratuities, and paid $604.25, which went to 1 town. Two hundred and four persons received premiums and 120 gratuities. Under head of farms $21 was awarded and paid; under farm and pet stock $339 was awarded and $336 paid; under field and experimental crops $6.50 was awarded and paid; under farm and garden products $72 was awarded and $71 paid; under dairy products $7 was awarded and paid; under domestic manufactures $102.50 was awarded and $101.25 paid; under trotting $21 was awarded and paid; under objects other than agricultural, not specified, $40.50 was awarded and paid. The society reports 494 members, — 203 males and 291 females. Four farmers' institutes were held at Nantucket: November 19, on "Cranberries and their culture, and best methods for keeping the berry;" November 26, on "Dairy farming;" December 3, on "Horses and poultry;" December 17, on "Breeding and feeding of dairy stock."

OXFORD AGRICULTURAL SOCIETY.

Incorporated 1888, Acts of 1888, chapter 93.

Originally raised by contribution $4,400; now has $8,131.68 invested as a capital stock in real estate, cash, crockery, tables, etc. Total assets, $8,121.68: real estate, $7,100; crockery, tables, etc., $200; cash, $831.68. Total liabilities, mortgages or like liabilities, $1,500. Receipts in 1892, $3,867.51: bounty, $600; new members, $59; donations, $34.25; other sources, $3,174.26. Expenditures in

1892, $3,035.83: premiums paid, $1,145.73; current running expenses, $400; interest, $87.50; other expenses, $1,402.60. The society offered in premiums $1,600, awarded $1,173, and paid $1,145.73, which went to 17 cities and towns. Forty-two dollars went to one city and one town outside the State. One hundred and forty-two persons received premiums. Under head of farms $43 was awarded and $42.50 paid; under farm and pet stock $491 was awarded and $468.91 paid; under field and experimental crops $43.25 was awarded and $42.19 paid; under farm and garden products $21.25 was awarded and $19.69 paid; under dairy products $8 was awarded and paid; under domestic manufactures $23 was awarded and $21.19 paid; under agricultural implements $9.50 was awarded and paid; under trotting $515 was awarded and paid; under objects other than agricultural, not specified, $19 was awarded and $18.75 paid. The society reports 633 members, — 343 males and 290 females. Three farmers' institutes were held: at Auburn, February 10, on "Will the agricultural interests of the country be promoted by reciprocity?" and "Grass culture;" at Charlton, March 25, on "Farms and fruit plantations of California and the far West;" at Oxford, December 22, on "Small fruits for family use" and "Orchard fruits and house plants."

PLYMOUTH COUNTY AGRICULTURAL SOCIETY.

Incorporated as the Agricultural Society in the County of Plymouth, 1819, Acts of 1819, chapter 2; name changed to Plymouth County Agricultural Society, in 1870, Acts of 1870, chapter 251.

The society in its first report to the Board in 1853 reported its permanent fund (par value) to be $9,550; now has $35,237.86 invested as a capital stock in real estate, cash, crockery, tables, etc. Total assets, $35,237.86: real estate, $35,000; crockery, tables, etc., $200; cash, $37.86. Total liabilities, notes, $1,900. Receipts in 1892, $14,991.36: bounty, $600; new members, $50; donations, $5,157.90; other sources, $9,183.46. Expenditures in 1892, $14,953.50: premiums and gratuities paid, $2,971.45; current running expenses, $2,946.89; interest, $79.10; other expenses,

$8,956.06. The society offered in premiums $3,722.50, awarded and paid $2,971.45 in premiums and gratuities, which went to 26 cities and towns. Four hundred and twelve dollars and fifty cents went to one city outside the State. Three hundred and thirty-four persons received premiums and 10 gratuities. Under head of farms $55 was awarded and paid; under farm and pet stock $745 was awarded and paid; under field and experimental crops $47 was awarded and paid; under farm and garden crops $194.20 was awarded and paid; under dairy products $32 was awarded and paid; under domestic manufactures $165.25 was awarded and paid; under trotting $1,675 was awarded and paid; under objects other than agricultural, not specified, $58 was awarded and paid. The society reports 1,603 members, — 944 males and 659 females. Three farmers' institutes were held: at East Bridgewater, February 25, on "The dairy" and "Cultivation of small fruits;" at Halifax, May 5, on "Sheep husbandry" and "The work of the Dairy Bureau;" at Bridgewater, December 20, on "Small fruits for family use" and "Flowers."

SPENCER FARMERS AND MECHANICS ASSOCIATION.

Incorporated 1888, Acts of 1888, chapter 87.

Originally raised by contribution $4,034.08; now has $7,800 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $7,914.47: real estate, $7,000; crockery, tables, etc., $800; cash, $114.47. Receipts in 1892, $3,123.62: bounty, $600; new members, $24; other sources, $2,499.62. Expenditures in 1892, $3,009.15: premiums and gratuities paid, $1,695.88; current running expenses, $932.27; interest, $81; reduction of debt, $300. The society offered in premiums $2,159.25, awarded in premiums and gratuities $1,713, and paid $1,695.88, which went to 24 cities and towns, one of which was outside the State. Two hundred dollars went to parties outside the State. One hundred and seventy-one persons received premiums and 22 received gratuities. Under head of farms $58 was awarded and paid; under farm and pet stock

$801.50 was awarded and $791.50 paid; under field and experimental crops $30 was awarded and paid; under farm and garden products $67 was awarded and $65.50 paid; under dairy products $10 was awarded and paid; under domestic manufactures $63.10 was awarded and $59.38 paid; under agricultural implements $10 was awarded; under trotting $480 was awarded and paid; under objects other than agricultural, not specified, $200 was awarded and paid. The society reports 957 members, — 532 males and 425 females. Three farmers' institutes were held: at Oakham, January 19, on "Milk and its production," and "Potatoes;" at Spencer, February 18, on "The tariff as it affects the farmer" and "Road building and maintenance;" at Brookfield, March 11, on "Taxation," and "Contagious diseases of animals."

UNION AGRICULTURAL AND HORTICULTURAL SOCIETY.

Incorporated 1867, Acts of 1867, chapter 110.

Originally raised by contribution $4,447.23; now has $10,632.89 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $10.659.04: real estate, $9,000; crockery, tables, etc., $1,632.89; cash, $26.20. Total liabilities, $1,694.20: premiums unpaid, $44.20; mortgages or like liabilities, $1,650. Receipts in 1892, $4,166.52: bounty, $600; new members, $166; donations, $143; other sources, $3,257.52. Expenditures in 1892, $4,140.32: premiums and gratuities paid, $1,105.50*; current running expenses, $815.40; interest, $6.25; other expenses, $2,213.17. The society offered $1,777.55 in premiums, awarded in premiums and gratuities $1,139.65 and paid $1,070.75, which went to 23 cities and towns. Eleven dollars and seventy-five cents went to 3 towns outside the State. One hundred and eighty-one persons received premiums and fifty-six gratuities. Under head of farms $5.50 was awarded and paid; under farm and pet stock $472.25 was awarded and $434 paid; under field and experimental crops $41 was awarded and paid; under farm and garden products

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* Thirty-four dollars and seventy-five cents were for premiums of 1891.

$41.25 was awarded and $38.37 paid; under dairy products $10.50 was awarded and $9.75 paid; under domestic manufactures $84.05 was awarded and $76.25 paid; under agricultural implements $15 was awarded and $5 paid; under objects other than agricultural, not specified, $96.68 was awarded and paid; under trotting, $349 was awarded and paid; under objects other than agricultural, not specified, $17.70 was awarded and $16.70 paid. The society reports 1,182 members, — 540 males and 642 females. Two farmers' institutes were held at Blandford: January 20, on "Fertilizers;" June 17, on "Fruits for farmers' use" and "Horses."

WEYMOUTH AGRICULTURAL AND INDUSTRIAL SOCIETY.

Incorporated 1891, Acts of 1891, chapter 77.

Amount originally raised by contribution had increased in 1891 to $10,270; invested as a capital stock in real estate, crockery, tables, etc. Total assets, $10,383.05: real estate, $10,000; crockery, tables, etc., $270; cash, $113.05. Liabilities, a mortgage of $1,500. Receipts in 1892, $4,819.23: bounty, $600; donations, $103.50; other sources, $4,115.73. Expenditures in 1892, $5,534.62: premiums paid, $655.10; current running expenses, $3,215.07; interest, $164.50; other expenses, $1,500. The society offered in premiums $888.25, awarded $723.35, and paid $655.10, which went to 19 cities and towns. Under head of farm and pet stock $414.25 was awarded and $376.50 paid; under field and experimental crops $8 was awarded and $7 paid; under farm and garden products $117.25 was awarded and $99.05 paid; under dairy products $4.50 was awarded and paid; under domestic manufactures $145.60 was awarded and $133.80 paid; under trotting $515 was awarded and paid; under objects other than agricultural, not specified, $33.75 was awarded and $32.75 paid. The society reports 451 members, — 444 males and 7 females. Three farmers' institutes were held at South Weymouth: February 22, on "Poultry;" September 3, on "Milch cows;" October 13, on "Farms."

WORCESTER AGRICULTURAL SOCIETY.

Incorporated 1818, Acts of 1818, chapter 168.

The society in its first report to the Board in 1853 reported its permanent fund (par value) to be $7,730; now has $140,000 invested as a capital stock in real estate. Total assets, $144,744.01: real estate, $140,000; bank funds, $4,544.01; crockery, tables, etc., $200. Liabilities, a mortgage of $50,000. Receipts in 1892, $34,966.43: bounty, $600; bank funds, $146.45; new members, $550; donations, $100; other sources, $33,569.98. Expenditures in 1892, $29,703.65: premiums and gratuities paid, $8,610.75; current running expenses, $10,088.29; interest, $2,118.76; other expenses, $8,887.83. The society offered $9,509 in premiums, awarded and paid $8,610.75 in premiums and gratuities, which went to 93 cities and towns. One thousand seven hundred thirty-two dollars and twenty-five cents went to 28 cities and towns outside the State. Three hundred and sixty-seven persons received premiums and 6 gratuities. Under head of farms $129 was awarded and paid; under farm and pet stock $3,633.75 was awarded and paid; under field and experimental crops $128* was awarded and paid; under farm and garden products $918 was awarded and paid; under dairy products $116 was awarded and paid; under domestic manufactures $131.75 was awarded and paid; under trotting $3,390 was awarded and paid; under objects other than agricultural, not specified, $292.25 was awarded and paid. In addition, diplomas were awarded for certain domestic manufactures, agricultural implements and other objects, strictly agricultural, not specified. Also medals were awarded for agricultural implements. The society reports 1,930 members, — 1,837 males and 93 females. Three farmers' institutes were held: at Holden, January 20, on "The cost of a quart of milk;" at Spencer, February 18, on "The tariff as it affects the farmer" and "Roads and bridges;" at Grafton, March 25, on "Farming as a business" and "Sheep husbandry."

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* Included in totals for farm and garden products.

WORCESTER EAST AGRICULTURAL SOCIETY.

Incorporated 1890, Acts of 1890, chapter 41.

Originally raised by contribution $1,015; now has $3,389.05 invested as a capital stock in real estate, cash, bank funds, crockery, tables, etc. Total assets, $3,389.05: real estate, $1,516.99; bank funds, $1,500; crockery, tables, etc., $172.70; cash, $199.36. Receipts in 1892, $4,889.98: bounty, $459.24; bank funds, $20.20; donations, $464; other sources, $3,882.54. Expenditures in 1892, $3,698.62: premiums and gratuities paid, $970.38; current running expenses, $2,708.44; other expenses, $11.80. The society offered in premiums $1,373,35, awarded in premiums and gratuities $1,045 and paid $970.38, which went to 15 cities and towns. One hundred and eighty-one persons received premiums and gratuities. Under head of farms $17 was awarded and paid; under farm and pet stock $492 was awarded and paid; under farm and garden products $318.75 was awarded and $304 paid; under dairy products $10 was awarded and paid; under domestic manufactures $62.25 was awarded and $61 paid; under agricultural implements $25 was awarded and paid; under trotting $600 was awarded and paid; under objects other than agricultural, not specified, $65 was awarded and $62 paid. The society reports 610 members, — 422 males and 188 females. Three farmers' institutes were held: at Sterling, February 9, on "Equipments in feeding dairy cows;" at Boylston, March 16, on "Small fruits for the farmer's table;" at Clinton, November 29, on "Methods of testing milk."

WORCESTER NORTH AGRICULTURAL SOCIETY.

Incorporated as the Fitchburg Agricultural Society, 1852, Acts of 1852, chapter 79; name changed to Worcester North Agricultural Society, 1853, Acts of 1853, chapter 359.

Originally raised by contribution $2,128; now has $4,187.31 invested as a capital stock in real estate, fixtures and cash. Total assets, $4,187.31: real estate, $2,500; crockery, tables, etc., $300; cash, $1,387.31. Receipts in 1892, $4,088.72: bounty, $600; bank funds, $60.60; new members, $31; donations, $150.50; other sources, $3,246.62.

Expenditures in 1892, $4,556.03: premiums and gratuities paid, $1,011.67; current running expenses, $3,544.36. The society offered $1,174.17 in premiums, and awarded and paid $1,011.67, which went to 13 cities and towns. Under head of farms $40 was awarded and $33 paid; under farm and pet stock $542.75 was awarded and $426.25 paid; under farm and garden products $295.02 was awarded and $254.52 paid; under dairy products $7.50 was awarded and $5.75 paid; under domestic manufactures $48.90 was awarded and paid; under agricultural implements $16 was awarded and paid; under objects other than agricultural, not specified, $100 was awarded and paid; under field sports $1,095 was awarded and paid; under trotting $520 was awarded and paid; under objects other than agricultural, not specified, $127.25 was awarded and paid. The society reports 776 members, — 722 males and 54 females. Four farmers' institutes were held: at Leominster, January 6, on "Small fruits for family use;" at Ashburnham, January 28, on "Poultry for profit" and "Fruit plantations of California and the far West;" at Ashby, March 9, on "Fruit plantations of California and the far West" and "Small fruits for the market;" at Westminster, March 22, on "Milk and its production."

WORCESTER NORTHWEST AGRICULTURAL AND MECHANICAL SOCIETY.

Incorporated 1867, Acts of 1867, chapter 117.

Originally raised by contribution $3,400; now has $10,642.25 invested as a capital stock in real estate, cash, crockery, tables, etc. Total assets, $10,642.25: real estate, $10,000; crockery, tables, etc., $400; cash, $242.25. Receipts in 1892, $3,944.20: bounty, $600; new members, $97.50; other sources, $3,246.70. Expenditures in 1892, $3,589.17: premiums paid, $1,702.76; current running expenses, $1,857.34; interest, $29.07. The society offered $2,510.50 in premiums, awarded $1,750.15 and paid $1,702.76, which went to 25 cities and towns. Seventy-five dollars went to one town outside the State. One hundred and seventy-eight persons received premiums.

Under head of farms $26 was awarded and paid; under farm and pet stock $648.25 was awarded and $628.57 paid; under farm and garden products $172.50 was awarded and $164.67 paid; under dairy products $17 was awarded and $16.33 paid; under domestic manufactures $36.40 was awarded and $32.02 paid; under agricultural implements $0.50 was awarded and $0.33 paid; under trotting $662.50 was awarded and paid; under objects other than agricultural, not specified, $187 was awarded and $172.34 paid. The society reports 903 members, — 609 males and 294 females. Three farmers' institutes were held: at Athol, January 29, on "The farmer as a citizen" and "How to make farming profitable;" at North Orange, February 12, on "Taxation" and "Dairying;" at Athol, February 19, on "Apples" and "Small fruits."

WORCESTER SOUTH AGRICULTURAL SOCIETY.

Incorporated 1855, Acts of 1855, chapter 278.

Originally raised by contribution $3,127.40; now has $8,500 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $8,623.04: real estate, $8,000; crockery, tables, etc., $500; cash, $123.04. Total liabilities, $1,077.10: premiums unpaid, $77.10; mortgages or like liabilities, $1,000. Receipts in 1892, $3,932.12: bounty, $600; new members, $68; other sources, $3,264.12. Expenditures in 1892, $3,689.37: premiums and gratuities paid, $1,656; current running expenses, $1,441.76; interest, $90; other expenses, $501.61. The society offered $2,070.25 in premiums, awarded $1,656 in premiums and gratuities and paid $1,578.90, which went to 27 cities and towns. One hundred and twenty-five dollars went to one town outside the State. One hundred and twenty-one persons received premiums and 65 gratuities. Under head of farms $74 was awarded and paid; under farm and pet stock $1,283.50 was awarded and $1,248 paid; under field and experimental crops $24.50 was awarded and $21.50 paid; under farm and garden products $93.95 was awarded and $79.70 paid; under dairy products $33 was awarded and $29 paid; under domestic manufactures $96.50 was awarded and $86 paid; under agricultural implements $6 was awarded and $3 paid; under objects strictly agricultural, not specified, $50 was awarded and paid; under trotting $575 was awarded and paid. The society reports 1,779 members, — 891 males and 888 females. Three farmers' institutes were held: at Southbridge, January 28, on "Abandoned farms" and "The work of the Weather Bureau;" at Brookfield, March 11, on "Single taxation, or the Henry George theory" and "Contagious diseases of animals;" at Sturbridge, December 16, on "Bringing up the farm," "The sheep industry" and "The use of liquid manure."

WORCESTER COUNTY WEST AGRICULTURAL SOCIETY.

Incorporated 1851, Acts of 1851, chapter 278.

Originally raised by contribution $3,175; now has $13,600 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $13,732.09: real estate, $12,600; bills due, $47.75; crockery, tables, etc., $1,000; cash, $84.34. Total liabilities, note, $1,000. Receipts in 1892, $4,537.67: bounty, $600; new members, $155; other sources, $3,782.67. Expenditures in 1892, $4,537.67: premiums and gratuities paid, $1,261.13; current running expenses, $3,276.54. The society offered $1,645.50 in premiums, awarded $1,293.20 in premiums and gratuities and paid $1,261.13, which went to 28 cities and towns. One hundred and thirty-eight persons received premiums and 43 gratuities. Under head of farms $35 was awarded and paid; under farm and pet stock $538.50 was awarded and $522.50 paid; under field and experimental crops $35 was awarded and $34.35 paid; under farm and garden products $51.75 was awarded and $46.88 paid; under dairy products $11 was awarded and paid; under domestic manufactures $38.25 was awarded and $35.85 paid; under agricultural implements $3 was awarded and paid; under trotting $519 was awarded and paid; under objects other than agricultural, not specified, $61.70 was awarded and $53.55 paid. The society reports 554 members, — 505 males and

49 females. Three farmers' institutes were held at Barre: January 15, on "Mixed rations for feeding milch cows" and "Agriculture past and present, and the duties of the farmer;" January 29, on "Pioneer farmers of the past and present and pioneer farmers of the future" and "Lights and shadows of the farmer's life;" February 19, on "How to win success" and "The old New England farmer and the young American agriculturist."

Summary.

	1891.	1892.
Number of societies,	*38	†38
Amount held invested or well secured as a capital stock,	$742,558 26	$757,407 44
Assets of societies,	776,831 26	838,379 45
Liabilities of societies,	116,190 39	118,046 24
Receipts,	208,292 30	222,737 17
Expenditures,	191,157 74	202,739 21
Bounty received from the State,	20,802 20	21,352 49
Current running expenses,	86,501 66	79,854 89
Amount of premiums offered,	79,645 61	78,787 46
Amount of premiums and gratuities awarded,	60,869 56	59,386 04
Amount of premiums and gratuities paid,	59,168 71	59,265 84
Amount awarded under head of farms,	1,440 00	1,428 00
Amount awarded under head of farm and pet stock,	22,145 79	21,776 95
Amount awarded under head of field and experimental crops,	1,029 63	1,460 00
Amount awarded under head of farm and garden products,	13,025 02	12,764 91
Amount awarded under head of dairy products,	686 75	616 80
Amount awarded under head of domestic manufactures,	3,655 49	3,833 06
Amount awarded under head of miscellaneous,	4,308 64	3,539 71
Amount awarded under head of trotting,	21,416 39	20,548 25
Number of persons receiving premiums,	7,480	7,265
Number of persons receiving gratuities,	2,225	1,746
Total male membership of the societies,	24,143	24,365
Total female membership of the societies,	7,465	7,372
Total membership of the societies,	31,608	31,747
Number of farmers' institutes held,	141	132

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* Two held no fair in 1891.

† Three held no fair in 1892.

ANNUAL MEETING

OF THE

BOARD OF AGRICULTURE

AT BOSTON.

January 31, February 1 and 2, 1893.

ANNUAL MEETING.

The Board met at the office of the secretary, in Boston, on Tuesday, Jan. 31, 1893, at 12 o'clock, it being the Tuesday preceding the first Wednesday in February. In absence of the Governor, Hon. J. S. GRINNELL was elected president *pro tem.*

Present: Messrs. Alger, Appleton, Bancroft, Bird, Bowker, Bucklin, Bursley, Clapp, Clemence, Cook, Cruickshanks, Cushman, Fowler, Goodell, Grinnell, Hartshorn, Harwood, Hersey, Holbrook, Horton, Kilbourn, Kimball, Mills, Newhall, Pratt, Rawson, Reed, Richards, Rowley, G. C., Rowley, J. H., Russell, Sargent, Shaler, Shaw, Taylor, Varnum, Ware, Ward, Warren, West and Wood.

The records of the meetings of the executive committee acting for the Board were read and approved, and their action adopted as the action of the Board.

A committee of three, to examine and report upon the credentials of newly elected members, was appointed by the Chair: Messrs. Bird, Varnum and Alger.

Adjourned to 2 P.M.

Board called to order by Mr. GRINNELL, at 2 P.M.

Mr. Hartshorn called attention to the fact that a fine picture of the late Charles L. Flint, the first secretary of the Board, and who served in that capacity for many years, had been presented to the Board by his son, Charles L. Flint; and moved that the thanks of the Board be presented to the donor for his very acceptable and valuable gift, which motion was unanimously adopted.

Voted, That the executive committee be instructed to secure if possible a suitable portrait of the second secretary of the Board, Hon. John E. Russell, that it may be hung upon the walls of the office of the Board.

The report of the committee appointed at the last annual meeting to take into consideration any changes that should be made in relation to the holding of fairs, and the advisability of trotting in connection with them, was read by the chairman, Mr. RAWSON, and the following recommendations were adopted: —

Voted, That the relations of the Board of Agriculture to the chartered agricultural societies of the State should be chiefly advisory, and beyond that, the Board should not seek to control the details of their management, except so far as they relate to the expenditure of the State bounty of six hundred dollars; but in the disbursement of that bounty this Board, as representing the State, should, from time to time, designate the objects for which it can be used, under the statute, prescribing certain rules and regulations as to its use, which each society should be required to follow in order to more fully carry out the real intention of the act, and to better promote the cause of agriculture throughout the State.

Voted, That in awarding premiums, especially on live stock, vegetables and fruits, there shall be established by this Board a scale of points, which shall be adopted by all the societies, so that there shall be a uniform standard throughout the State.

Voted, That in awarding prizes for butter and cheese, field crops and experiments, a written statement shall accompany each entry, setting forth how the butter or cheese was made, the crop raised, or the experiment conducted; in short, giving a brief history in relation to the matter.

Voted, That in the judging of all live stock, fruit and vegetables, each society shall employ an expert, or experts, unless excused by the executive committee of the Board. These expert judges shall be instructed to appoint a time for listening to appeals, and to give their reasons for the decisions at which they have arrived, if called for; but their decisions shall be final.

Voted, That a separate account of the State bounty shall be kept, which shall set forth, on one side, the money received from the State, and on the other side, the money paid out, and for what object, and to whom paid in the live stock classes; and a transcript of this account shall be furnished to the secretary of this Board on or before the first of December of each year.

The report of the Dairy Bureau was presented in print, accepted and adopted by the Board, and will be found printed in this volume.

The secretary made report on the societies failing to comply with the laws of the State and the regulations of the Board, which report was referred to the chairman of the executive committee, with instructions to report recommendations of action.

The chairman reported that the secretary be instructed to notify the several societies that these delinquencies are excused, but that compliance with all laws and regulations will be insisted upon in the future.

The following resolve was offered by Mr. Appleton, and referred to a special committee, consisting of Messrs. Appleton, Hartshorn and Shaw, with instructions to report at the next public winter meeting: —

Resolved, That the value of agricultural fairs, as promotive of improvement in the State's agriculture, depends upon the quality of the products of our farms exhibited at them.

Resolved, That, in the opinion of this Board, it would promote the cause of agriculture in Massachusetts to have exhibits of herds of selected milch and butter cattle, and of selected specimens of other live stock suited to use on Massachusetts soil, and of other similarly selected products of the farm, made triennially under such supervision as shall guarantee a high quality of such exhibits.

Resolved, That we recommend to the Legislature of Massachusetts to authorize such a plan of exhibit, under the auspices of suitable and responsible organizations, in some convenient location, where suitable shelter to persons and exhibits shall be provided, and that the State guarantee against loss in such work to the extent of $10,000 for each triennial exhibition.

Resolved, That three classes of certificates of merit be awarded to exhibitors, instead of cash prizes at such exhibitions; and that suitable cash payment be made for each animal, and for collections of farm products, that are secured for exhibition.

At 4.45 o'clock the Board adjourned to 9.30 o'clock, Wednesday.

SECOND DAY.

The Board met at 9.30 A.M., Mr. GRINNELL in the chair.

Present: His Honor Roger Wolcott, Messrs. Alger, Appleton, Bancroft, Bird, Bowker, Bucklin, Bursley, Clapp, Clemence, Cook, Cruickshanks, Cushman, Damon, Fowler, French, Goodell, Grinnell, Hartshorn, Harwood, Hersey, Holbrook, Horton, Kilbourn, Kimball, Mills, Newhall, Pratt, Rawson, Reed, Richards, Rowley, G. C., Rowley, J. H., Russell, Sargent, Shaler, Shaw, Taylor, Varnum, Ware, Ward, Warren, West and Wood.

Voted, That the secretary be instructed to notify each agricultural society receiving the State bounty, as soon as he can conveniently do so, of any vote or votes passed by this Board at this meeting relating to said societies.

The committee on credentials of newly elected members reported the following: —

At large, appointed by the Governor, —
  JAMES S. GRINNELL of Greenfield.

Elected by the societies, —
  Bay State, J. D. W. FRENCH of Andover.
  Bristol County, N. W. SHAW of North Raynham.
  Deerfield Valley, CHAS. E. WARD of Buckland.
  Essex, FRANCIS H. APPLETON of Peabody.
  Highland, H. A. BARTON, Jr., of Dalton.
  Hillside, WM. BANCROFT of Chesterfield.
  Middlesex South, ISAAC DAMON of Wayland.
  Nantucket, WM. W. MCINTOSH of Nantucket.
  Plymouth, AUGUSTUS PRATT of North Middleborough.
  Worcester, C. L. HARTSHORN of Worcester.
  Worcester North, GEO. CRUICKSHANKS of Fitchburg.
  Worcester County West, E. A. HARWOOD of North Brookfield.

Which report was accepted.

Voted, On motion of Mr. Richards, that the executive committee be instructed to investigate the standing of the Bay State Agricultural Society and other societies, and report at the next public winter meeting, and that the committee be authorized and instructed to take proper means to get the opinion of the Attorney-General in the matter.

The following committees of three were appointed: —

On assignment of delegates: Messrs. Hartshorn, Kilbourn and Cook.

On place of holding the public winter meeting: Messrs. Wood, Newhall and French.

On change of time for holding fairs: Messrs. Bancroft, Fowler and Ward.

On essays for the next annual meeting: Messrs. Bowker, Rawson and West.

To nominate members of the executive committee: Messrs. Pratt, Cruickshanks and Clemence.

To nominate members of the examining committee of the Agricultural College: Messrs. Appleton, Hartshorn and Shaw.

The report of the gypsy moth committee was read by the secretary, accepted and adopted, and the request of the committee for appropriation for next year's work was approved. The report will be found printed in this volume.

Voted, On recommendation of the gypsy moth committee, that hereafter the committee consist of five members.

Voted, That the Chair appoint a committee to nominate members of the gypsy moth committee. Messrs. Newhall, Hartshorn and Clemence were appointed.

The report of the examining committee of the Agricultural College was read by the chairman, Mr. Chas. A. Mills, and was by vote of the Board accepted, and adopted as the report of the Board of Agriculture to the Legislature. The report will be found printed in this volume.

The secretary made report of the work of the past year under the law for collecting and circulating information on abandoned and partially abandoned farms. The report was accepted and adopted, and the request for an appropriation of $1,000 for the continuation of the work was approved.

Voted, That the secretary and the committee on legislation petition the Legislature for a law regulating the sale of commercial feed-stuffs, in accordance with a law proposed by the committee of the Board of Control of the State Agricultural Experiment Station.

At 12.30 the Board adjourned to 2 P.M.

The Board was called to order at 2 P.M., Mr. GRINNELL in the chair.

Mr. Bancroft, for the committee on change of time for holding fairs, reported that the changes asked for by the Martha's Vineyard, Attleborough, Middlesex North and Middlesex South be authorized, and that the Essex Society be allowed to choose between the week preceding and the week following the week on which the Amesbury and Salisbury Society holds its fair, and that the executive committee be instructed to ratify, in the name of the Board, the choice thus made.

Voted, To accept and adopt the report of the committee, and authorize the changes recommended, and to empower the executive committee to decide the case of the Essex Society.

The secretary read an abstract of the reports of delegates to fairs, which reports were accepted.

The committee on place for holding the public winter meeting reported, by its chairman, that the meeting should be held at Great Barrington. The report was accepted, and the Board voted to hold the next public winter meeting at Great Barrington.

A committee of arrangements for the public winter meeting was appointed: the secretary and Messrs. J. H. Rowley, Barton, G. C. Rowley, Bancroft and Mills.

Mr. Appleton, for the committee to nominate members of the examining committee of the Agricultural College, reported the nomination of Messrs. George Cruickshanks and E. A. Harwood, who were elected.

Mr. Pratt, for the committee to report names for executive committee, reported the names of Messrs. Wood, Hersey, Hartshorn, Rawson and Varnum, who were elected.

Voted, That Messrs. Wood, Hartshorn, Appleton and the secretary be the committee on legislation for the ensuing year.

Mr. Hartshorn, for the committee on assignment of delegates, reported the following : —

Amesbury and Salisbury (Agricultural and Horticultural), ...	W. W. Rawson.
Attleborough (Agricultural Association),	Wm. Bancroft.
Barnstable County, ...	E. A. Harwood.
Berkshire, ...	F. W. Sargent.
Blackstone Valley, ...	A. J. Bucklin.
Bristol County, ...	L. S. Richards.
Deerfield Valley, ...	Augustus Pratt.
Eastern Hampden, ...	Q. L. Reed.
Essex, ...	N. S. Shaler.
Franklin County, ...	J. Bursley.
Hampden, ...	J. H. Rowley.
Hampshire, ...	E. Warren.
Hampshire, Franklin and Hampden, .	C. A. Mills.
Highland, ...	Isaac Alger.
Hillside, ...	E. W. Wood.
Hingham (Agricultural and Horticultural),	W. A. Kilbourn.
Hoosac Valley, ...	W. H. Bowker.
Housatonic, ...	C. F. Fowler.
Marshfield (Agricultural and Horticultural),	L. W. West.
Martha's Vineyard, ...	G. C. Rowley.
Massachusetts Horticultural, ...	G. Cruickshanks.
Middlesex, ...	E. Cushman.
Middlesex North, ...	E. C. Clapp.
Middlesex South, ...	N. W. Shaw.
Nantucket, ...	C. L. Hartshorn.
Oxford, ...	Isaac Damon.

Plymouth County, ...	J. C. Newhall.
Spencer (Farmers' and Mechanics' Asso.),	C. E. Ward.
Union (Agricultural and Horticultural), .	J. E. Kimball.
Weymouth (Agricultural and Industrial),	E. Hersey.
Worcester, ...	H. A. Barton, Jr.
Worcester East, ...	Wm. W. McIntosh.
Worcester North, ...	H. A. Cook.
Worcester North-west, ...	G. L. Clemence.
Worcester South, ...	Wm. Holbrook.
Worcester County West, ...	F. H. Appleton.

Report accepted and adopted.

On motion of Mr. Appleton, *Resolved*, That the State Board of Agriculture approves the efforts of the Massachusetts Horticultural Society, and other societies and persons, to obtain effective and judicious legislation in aid of the suppression of the tent caterpillars, tussock moth, canker worm and other insect pests.

Dr. J. B. Lindsey, associate chemist at the State Agricultural Experiment Station, read an essay on the "Work of the German Experiment Stations," which was accepted, and will be found printed in this volume.

At 4.45 the Board adjourned to 9.30 o'clock, Thursday.

THIRD DAY.

The Board met at 9.30 a.m., Mr. Grinnell in the chair.

Present: Messrs. Alger, Appleton, Bancroft, Bowker, Bucklin, Bursley, Clapp, Clemence, Cook, Cruickshanks, Cushman, Damon, Fowler, French, Grinnell, Hartshorn, Harwood, Hersey, Holbrook, Horton, Kilbourn, Kimball, Mills, Newhall, Pratt, Rawson, Reed, Richards, Rowley, G. C., Rowley, J. H., Russell, Sargent, Shaw, Taylor, Varnum, Ward, Warren, West and Wood.

Mr. Ward, of the Deerfield Valley Agricultural Society, presented the request of his society for a change in the rule of the Board which requires the premiums awarded to be designated by colors, first blue, second red and third white, so that it may be first red, second white and third blue.

Voted, That the request be referred to the executive committee, with instructions to consider it, and report recommendations to the next annual meeting.

Voted, That the election of secretary and other officers be assigned to 2 o'clock.

Mr. J. E. Kimball read an essay on "The Relation of Public Schools to Agriculture," which was accepted, and will be found printed in this volume.

Mr. Q. L. Reed read an essay on "The Benefits Resulting from Agricultural Societies," which was accepted, and will be found printed in this volume.

Voted, On motion of Mr. Bancroft, that the thanks of the Board be transmitted by the secretary to the Massachusetts Agricultural College Alumni Club of Massachusetts for the handsome entertainment accorded to the Board last evening.

Mr. L. S. Richards read an essay on "Going West," which was accepted, and will be found printed in this volume.

The secretary presented a communication from the chairman of committee on Good Roads Congress, asking election of a member for advisory council, and for the appointment of two delegates to Good Roads Congress at Chicago in October next.

Voted, That the Board accept the invitation, and empower the secretary and chairman of the executive committee to appoint a member for the council and the two delegates.

Voted, That the matter of transportation of milk by rail be referred to the committee on legislation, with instructions to consider the matter of legislation controlling the freight charges of the railroads, and, if in their judgment it is proper and necessary, to favor such legislation.

Voted, On motion of Mr. Bowker, that the secretary of this Board be instructed to notify the secretaries of the different agricultural societies of the State that it will be permissible for the societies to offer a part or all of the State bounty as special or State premiums, to be awarded on cards bearing the coat of arms of the State, which this Board will supply on request; and it is recommended that the societies, so far as they are able, try this plan with some or all of the classes to which the State bounty is applicable.

Voted, On motion of Mr. Appleton, that the secretary be directed to prepare suitable distinguishing badges to be worn by members of the Board while on duty as members of the Board of Agriculture.

At 12.30 the Board adjourned to 2 P.M.

The Board was called to order at 2 P.M., Mr. GRINNELL in the chair.

The special assignments were called up, and Wm. R. Sessions was re-elected secretary.

Mr. Newhall, for the committee to nominate members of the gypsy moth committee, reported the names of Messrs. Shaler, Appleton, Wood, Bowker and the secretary.

The election of the gypsy moth committee being in order, a ballot was called for, and resulted in the choice of Messrs. Sessions, Shaler, Appleton, Wood and Bowker.

Voted, On motion of Mr. Appleton, that the executive committee be instructed to take under consideration the present law as to the appropriation and use of the State bounty, and consider what legislation, or change of the Board's rules, is necessary to permit the use of a portion thereof for institute and other educational work; and that this work, combined with its use for premiums, may become the basis of the allotment of bounty; this in no way to interfere with the lectures of this Board as now prescribed.

Voted, On motion of Mr. Bowker, that the Chair appoint a committee of three, to codify the rules and regulations of the Board and all existing by-laws, to prepare such further by-laws as may seem necessary, to recommend the appointment of certain standing committees for the performance of certain specified work, and to report at the next public winter meeting of the Board. The Chair appointed Messrs. Bowker, French and Appleton as the committee.

The committee on essays for the next annual meeting reported, by its chairman, Wm. H. Bowker, as follows: —

ESSAYS.

The Restoration of Exhausted Farms by Practical Methods,	ELBRIDGE CUSHMAN.
Tobacco Culture,	C. F. FOWLER.
Sheep on Our Western Hills,	WM. BANCROFT.
Cranberry Culture,	EDMUND HERSEY.

Report accepted and adopted.

Voted, That the executive committee make a list of suitable men to perform the duty of experts in the different classes in which the Board requires experts, and that such list be kept for the information of societies.

Voted, That any unfinished business or any new business that may arise before the next annual meeting be left in the hands of the executive committee, with full power to act for the Board.

A vote of thanks was unanimously tendered the chairman, Mr. Grinnell, for the able and indulgent manner in which he had discharged his duty as presiding officer.

Voted, That when the Board adjourn it be to the first evening of the public winter meeting at Great Barrington, in December next.

The minutes of the meeting were read and approved.

Adjourned.

WILLIAM R. SESSIONS,
Secretary.

AGRICULTURAL EXHIBITIONS, 1893.

AMESBURY AND SALISBURY at *Amesbury*, September 26, 27 and 28.
ATTLEBOROUGH at *North Attleborough*, October 3, 4 and 5.
BAY STATE (holds no fair this year).
BARNSTABLE COUNTY at *Barnstable*, September 12, 13 and 14.
BERKSHIRE at *Pittsfield*, September 12 and 13.
BLACKSTONE VALLEY at *Uxbridge*, September 26 and 27.
BRISTOL COUNTY at *Taunton*, September 27, 28 and 29.
DEERFIELD VALLEY at *Charlemont*, September 14 and 15.
EASTERN HAMPDEN at *Palmer*, September 19 and 20.
ESSEX at *Haverhill*, September 19, 20 and 21.
FRANKLIN COUNTY at *Greenfield*, September 21 and 22.
HAMPDEN at *Westfield*, September 21 and 22.
HAMPSHIRE at *Amherst*, September 26 and 27.
HAMPSHIRE, FRANKLIN AND HAMPDEN at *Northampton*, September 19 and 20.
HIGHLAND at *Middlefield*, September 6 and 7.
HILLSIDE at *Cummington*, September 26 and 27.
HINGHAM at *Hingham*, September 26 and 27.
HOOSAC VALLEY at *North Adams*, September 19, 20 and 21.
HOUSATONIC at *Great Barrington*, September 27, 28 and 29.
MARSHFIELD at *Marshfield*, September 13, 14 and 15.
MARTHA'S VINEYARD at *West Tisbury*, September 19 and 20.
MASSACHUSETTS (holds no annual fair).
MASSACHUSETTS HORTICULTURAL at *Boston*, October 3, 4 and 5.
MIDDLESEX at *Medford*, September 19 and 20.
MIDDLESEX NORTH at *Lowell*, September 14, 15 and 16.
MIDDLESEX SOUTH at *Framingham*, September 12 and 13.
NANTUCKET at *Nantucket*, September 6 and 7.
OXFORD at *Oxford*, September 19 and 20.
PLYMOUTH COUNTY at *Bridgewater*, September 20, 21 and 22.
SPENCER at *Spencer*, September 21 and 22.
UNION at *Blandford*, September 13, 14 and 15.
WEYMOUTH at *South Weymouth*, September 28, 29 and 30.
WORCESTER at *Worcester*, September 5, 6, 7 and 8.
WORCESTER EAST at *Lancaster*, September 14 and 15.
WORCESTER NORTH at *Fitchburg*, September 19 and 20.
WORCESTER NORTH-WEST at *Athol*, October 3 and 4.
WORCESTER SOUTH at *Sturbridge*, September 14 and 15.
WORCESTER COUNTY WEST at *Barre*, September 28 and 29.

REPORT TO THE LEGISLATURE OF THE STATE BOARD OF AGRICULTURE, ACTING AS OVERSEERS OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

[P. S., chap. 20, sect. 5, adopted by the Board Feb. 1, 1893.]

The power and usefulness of the Massachusetts Agricultural College and experiment stations are more and more impressed upon the members of the visiting committee of the Board of Overseers. The work of the past is secure, of the present is efficient; towards the future we look with assurances of increased usefulness and prosperity. Agricultural colleges and experiment stations in the United States are exerting, it is claimed, the most powerful concerted educational force in the world. Happily, farmers themselves are recognizing their worth; here, in increasing numbers, they are sending their sons for instruction; more and more are they realizing that from these centres of investigation conclusions are being arrived at that are essential to the highest success of the husbandman. To hold the Massachusetts Agricultural College in the fore front of similar institutions demands increased generosity from the State, untiring effort and devotion on the part of all interested in her welfare. The college is proud of her mother; she looks forward to a glorious future with assured confidence, because she is a child of the State of Massachusetts; she turns to this mother for assistance and support, knowing that in all her grand history Massachusetts has never turned a deaf ear to the needs of her schools and colleges. Grateful for past generosity, she hesitates not to ask even more in the future. We say the college is proud of her mother; equally true, the mother has reason to be proud of this child, and constantly watchful and solicitous for her welfare. Unsurpassed for beauty of location, the purposes and aims of this college call forth her deepest affection, devoted as she is to the work of making agriculture even more noble, because of the increased intelligence of the farmer. Watchful, knowing, if Massachusetts agriculture is to hold its place in the fierce struggle of competition, it must be manned by the educated mind and trained skill of her farmer citizens; solicitous, since the farmer has shaken off the dust of seclusion, is sounding his voice and demanding a hearing in the councils of both State and nation; remembering that his voice can be safely heard and followed, not alone because the farmer speaks, but better because the farmer speaks wisely. Among all her sons the State has no surer promise of the future patriotic, manly, useful citizen than from these farmers' boys, gathered at the Agricultural College.

The work of the college and experiment stations seems increasingly useful and dignified when we remember its threefold nature: first, the instruction of those committed to their care; second, practical and scientific results that are being reached by experiments; third, the object lesson furnished in the various departments.

To pass an intelligent judgment upon work being done in class rooms, to measure accurately efficiency of instruction, faithfulness in study and habits of application, require closeness of touch with the internal workings of the college, that which your committee has not been able to secure. We have attended recitations from time to time, and have thus been assured, by personal inspection, that earnest, faithful work is being done by both instructors and students. Your committee heard the essays and oral examination of the senior class in agriculture, as usual.

The Grinnell prizes were awarded: first, to Henry Martin Thomson of Monterey; second, to Henry Bennett Emerson of Gloucester.

These exercises are worthy of commendation; it is not to detract from their excellence when we suggest that the aim should be to develop greater facility and readiness in powers of expression through the entire course of training. Our times demand men that not only have accumulated knowledge and powers of thought, but who can also forcibly and readily give utterance to such knowledge by voice and pen.

Your committee hail with satisfaction the introduction of the new and shorter course of instruction recently adopted by the board of trustees. This will admit of better classification, and will secure the attendance of many not able to avail themselves of the longer course.

A cursory examination of the experiment stations assures us of the patient and thorough work being there done; the bulletins issued during the year for general distribution confirm this estimate. We call particular attention to the facts brought out in Bulletin No. 45, from the State Experiment Station, entitled "Fodder Articles and Fodder Supplies." Conclusive proof is here given of the wisdom of proposed legislation with reference to legal inspection of waste feed products offered for sale in the State. The station is especially fortunate in having as its director one who stood foremost in advocating and bringing about legal restrictions with reference to the inspection and sale of commercial fertilizers, and who is now baring his arm to bring about this second reformation for the farmer's benefit.

We learn with satisfaction that the experiment departments are more and more addressed by letters from citizens in the State, seeking information on a great variety of subjects in which the practical farmer is interested. If such questions and answers could be made public through the press, your committee feel that much useful information would thus have a wider distribution.

We have elsewhere indicated that one function of the college is the object lesson. The ideal should be striven for in every department, not alone for its influence upon the young men in course of training, but as a stimulus and incentive to every citizen of the State who will visit these grounds and buildings, and so come in touch with an object lesson in the various departments, which should be worthy of imitation in successful agriculture. By word and pen arouse a desire to make such visits; thus educate our farmers to feel that the Agricultural College is the Mecca to which one pilgrimage at least must be made. The more perfect the object lesson, the more enthusiasm will be aroused.

If important conclusions are reached at the experiment stations, the farm and horticultural departments serve their greatest usefulness by putting these same conclusions into practice, simplifying methods to the understanding and wants of the practical working farmer. If this be true, then the primary and leading purpose of the horticultural department should be the culture and exhibit of the widest possible range of plants, vegetables and fruits, from which the Massachusetts producer can obtain a livelihood.

We note with satisfaction the completion of the Durfee plant house, the grapery and the tool house during the past year; beauty and utility are thus happily brought into effect. With these increased facilities we urge that a department affording such valuable instruction and information in one of the most remunerative branches of Massachusetts farming be no longer restricted in its development to a self-sustaining basis. By all means let the business side be kept in view; by no means let it be the controlling purpose. The repeated and urgent requests of the efficient and enthusiastic head of this department should be answered favorably.

The management and cultivation of the lands of the farm seem admirable and to well meet the high standard we have suggested. Thirty-five acres of corn in one plot is an unusual sight in New England, — this, too, upon lands but recently an unproductive swamp. The amounts and kinds of fertilizers used, the variety of seed, the manner of cultivation, the comparative value of the harvested product, whether as silage or husked corn and stover, are all subjects of live interest. The general result that sixty dollars' worth of food was here obtained with thirty dollars' worth of effort, and this, too, upon lands so recently worthless, is surely encouraging to the growing of corn in Massachusetts. Could every acre devoted to the corn crop in Massachusetts be made, by more intelligent methods, to show equal returns, it would give to our farmers a larger annual sum than the entire yearly expense of maintaining the Agricultural College.

While the lands and crops of the college farm afford satisfaction, the stock barn in no sense meets present requirements. Its early abandonment seems an absolute necessity; in many essential particulars we should be unwilling to commend it as having any value as an object lesson. Stabling cattle over a basement where their excrements are deposited no longer commends itself to our most intelligent stockmen; storing fodder in lofts above cattle is of questionable utility. We are informed that the sanitary conditions of this barn are such that two breeds of cattle (Jerseys and Guernseys) have become extinct. We are convinced that from every point of view money for the erection of a stock barn, complete in its appointments, healthful in its sanitary arrangements, centrally located with reference to gathering the crops of the farm, should be asked of the State without delay. A desirable adjunct to this barn would be a dairy room, equipped with modern implements for creaming milk and manufacturing butter. At one of our visits to the college in May last we found the Dairy Bureau conducting a dairy school in the presence of the senior class. This exercise seemed to us so useful that the question arises whether the milk produced upon the farm should not be manufactured there by the most skilled methods, thus affording a daily object lesson in this important industry.

In the near future we hope to see a well-arranged poultry house on the farm, with the leading varieties of fowls. An industry representing an annual income of over two million dollars deserves recognition.

The past growth of the college has been as rapid as is consistent with normal development; its future is full of hope. The lines of its usefulness, viz., instruction, investigation, the object lesson, we have indicated; the harmonious development of each of these lines means a sure and permanent hold upon a constantly increasing constituency.

Respectfully submitted,

CHAS. A. MILLS.
A. C. VARNUM.
W. A. KILBOURN.
GEORGE CRUICKSHANKS.
WM. HOLBROOK.
GEO. L. CLEMENCE.

THE AGRICULTURAL EXPERIMENT STATIONS OF GERMANY.

BY DR. J. B. LINDSEY OF AMHERST.

It is my purpose to ask your attention (I.) to some general information relative to the German experiment stations, and (II.) to a consideration of some of the work in which the stations are now engaged, and to the methods employed in its execution.

I.

GENERAL INFORMATION.*

The stations of the German empire may be divided into two classes: first, those belonging to what is known as the Union of Agricultural Experiment Stations of Germany; and second, those outside the union. Many of the stations within the union are largely engaged in control work, some do only control work, while others are investigating special problems in plant and animal nutrition, plant disease, soil physics, etc. The *Union of stations* was established in 1888, and had for its object the furthering of the mutual interests of the stations, both in scientific and practical ways, and especially in enabling them to secure uniformity in methods of analysis and inspection of fertilizers, fodders, seeds and other important agricultural materials. The methods now in use for control and inspection work are very similar to those employed by the American Association of Agricultural Chemists of the United States.

The stations outside the Union are more generally in connection with the German universities, and are officered by various professors, who carry on investigations in their specialties. The German professor, when compared with the average professor and teacher in our agricultural colleges, has comparatively little teaching to do, and his time is largely spent in original inquiry.

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* See statistics of the German stations in Mentzel and von Lengerke's Landwirthschaftlicher Kalender for 1893, compiled by Professor Nobbe.

The number of stations within the German union is forty-seven, while those outside number twenty, making a total of sixty-seven within the German empire. Prussia has thirty-five, Bavaria ten, Saxony six, Würtemberg, Baden, Anhalt and Hamburg two each, while Brunswick, Hessen, Mecklenburg, Weimar, Meiningen, Oldenburg, Bremen and Alsace each has one. Each of these sixty-seven stations has a director, and some an assistant director. The stations employ many special investigators, about a hundred and fifty chemists, four botanists, six seed inspectors, besides secretaries, gardeners, laboratory helpers, etc. Thirty-five stations exercise analytical control and examination over the sale of commercial fertilizers, fodders and seeds; ten conduct experiments in animal nutrition; twenty-three in plant physiology; four examine foods and beverages; three conduct experiments in beer brewing; two devote themselves exclusively to plant diseases; four to sugar beet culture; two exclusively to fruit culture; one to investigations in veterinary science; one to dairying; one to the improvement of marsh lands; and one to agricultural physics. Some eight or ten give their entire time to scientific research, doing no control work of any kind. Many of the stations are equipped with vegetation houses for conducting experiments in vegetable physiology; two stations, one at Göttingen and one at Möckern, have the Pettenkofer respirations apparatus, and one at Berlin a horse dynamometer.

The income of the German stations is as a rule much smaller than that received by the stations of the United States. It is derived from the general and provincial governments, from agricultural societies and from analyses fees. It is a noticeable fact that many of the stations are supported in whole or in part by agricultural societies, and are concerned with the investigation of special problems, on which the society desires information.

The first agricultural experiment station was established at Möckern, near Leipsig, in 1851. In 1861 we find nine stations in operation; in 1871, twenty-three; in 1881, fifty; and finally, in 1892, sixty-seven.

The German stations in their earlier days carried on a *great variety* of investigations; but they soon learned to specialize, to study fewer subjects, and to study them more exhaustively. More attention is now being given to work in the laboratories, in the greenhouse and the stables, and less to the farm and garden; *i. e.*, they have found that many of the questions asked them by agriculturists are of so difficult a nature as to require long and careful study, under conditions where all circumstances can be controlled. Many of the stations in former years were situated on large farms, but they have been gradually moving towards the cities and universities, in order that the assistance of the ablest scientific investigators might be secured.

Statistics of the Agricultural Experiment

DIVISIONS OF GERMAN EMPIRE.	LOCATION, CITY OR TOWN.	Date of Organization.	INCOME.†				WORKING FORCE.			
			From Government.	From Agricultural Societies.	From Analyses, etc.	Total.	Directors.	Assistants.	Secretaries.	Janitors, servants, etc.
	Stations in the Association.									
Prussia,	Insterburg,	1858	$1,375	$300	$1,500	-	1	2	-	-
	Königsberg,	1875	1,375	-	2,250	-	1	2	-	-
	Königsberg (dairy laboratory of Agricultural Institute of University).	1887	-	-	-	-	2	3	-	-
	Danzig,	1877	1,075	-	-	-	2	1	-	-
	Dahme,	1857	2,550	-	-	-	1	3	-	-
	Regenwalde,	1863	‡1,725		-	-	1	2	-	-
	Eldena,	1878	-	125	-	-	1	-	-	-
	Posen (by union of stations from Kuschen, 1861, and Bromberg, 1873).	1877	3,225	750	-	-	1	1	-	-
	Breslau (transferred from Ida-Marienhütte).	1877	1,125	-	-	-	1	3	-	-
	Halle (transferred from Salzmünde).§	1865	1,500	-	10,750	$ 12,250	1	10	1	5
	Halle (Agricultural Institute of University).	1863	-	-	-	-	1	4	-	-
	Kiel,	1871	3,000	‖850	2,125	5,975	2	5	-	-
	Kiel (Agricultural Institute),	-	-	-	-	-	1	-	-	-
	Göttingen,	1857	2,500	-	-	-	1	2	-	-
	Göttingen (control station),	1892	-	-	-	-	1	-	-	-
	Hildesheim,	1870	-	-	-	5,000	1	3	-	-
	Ebstorf,	1871	-	-	-	-	1	-	-	-
	Münster,	1871	2,825	590	3,275	6,690	1	6	-	-
	Marburg,	-	-	-	-	-	1	2	-	-
	Wiesbaden,	1881	-	-	-	-	1	1	-	-
	Geisenheim,	1872	-	-	-	-	1	2	-	-
	Bonn,	1856	1,785	-	4,920	6,750	1	4	1	2
	Poppelsdorf,	1856	2,681	-	-	-	2	2	-	-
Bavaria,	Munich,	1857	-	-	-	3,500	1	3	-	2
	Augsburg,	1865	-	1,125	1,181	2,481	1	1	-	-
	Würzburg,	1877	-	-	-	1,000	1	1	-	-
	Speyer,	1875	1,025	1,250	1,500	3,775	1	3	-	-
	Triesdorf,	1874	475	-	-	-	1	1	-	-
Saxony,	Möckern,	1851	-	-	-	6,600	1	6	-	-
	Dresden,	1890	3,000	-	-	-	1	2	-	-
	Pommritz,	1857	-	-	-	4,442	1	3	1	2
	Tharand,	1869	2,500	75	500	-	1	4	-	1
Würtemberg,	Hohenheim,	1865	2,750	-	500	-	1	2	-	-
Baden,	Karlsruhe,	1859	3,250	-	-	-	1	2	-	-
	Karlsruhe,	1872	-	-	-	1,650	1	2	-	-
Hessen,	Darmstadt,	1871	-	-	-	6,250	1	2	-	-
Oldenburg,	Oldenburg,	1876	-	-	-	-	1	-	-	-
Brunswick,	Brunswick,	1862	-	-	-	3,750	1	2	-	-

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* This compilation is taken from the Experiment Station Record, and corrected to July, 1892.

† One dollar equals four marks.

‡ Income from both government and agricultural societies.

*Stations of the German Empire, July, 1892.**

Inspection			Special Lines of Work.	Equipment.
Fertilizers.	Feeding Stuffs.	Seeds.		
+	-	+	Vegetable physiology; inspection of foods and beverages.	
+	+	+	Scientific research.	
-	-	-	Scientific research; dairying, ...	Experiment dairy founded in 1887.
-	-	+	Scientific research; seed control.	
+	+	+	Vegetable physiology (mainly).	
-	-	+	Vegetable physiology; soil investigations, . .	Vegetation house.
+	+	+	Fertilizers; feeding stuffs; seeds.	
+	+	+	Animal nutrition; plant culture; agricultural technology.	Vegetation house; stable to be built.
+	+	+	Vegetable and animal nutrition, ...	Well-equipped laboratory in a building of Agricultural Institute of University.
+	+	+	Vegetable and animal nutrition; agricultural technology.	Large and well-equipped laboratory; vegetation house.
-	-	-	. . . .	Physiological laboratory; experiment field; Haustiergarten.
+	+	+	Animal and vegetable chemistry; tests dairy methods and apparatus, and gives instruction in dairying.	Chemical laboratory; experiment dairy; stables, etc.
-	-	+	Seed control. .	
-	-	-	Nutrition of animals, ...	Pettenkofer's respiration apparatus; stables for cattle, sheep, swine, etc.
+	+	+	Fertilizers; fodder and seed control.	
+	+	+	Agricultural technology; experiments with fertilizers.	
+	+	+		
+	+	+	Scientific research.	
-	-	+	Chemistry; seed control.	
+	+	-	Scientific research.	
-	-	-	Chemistry; vegetable physiology; fruit and vine culture.	
+	+	+	Inspection of foods; agricultural technology.	
-	-	-	Chemistry; vegetable physiology, . . .	Separate laboratory and field for field experiments.
+	+	+	Animal and vegetable physiology, . . .	Laboratory; collections; experiment stables and garden.
+	+	+	Scientific investigations of fertilizers.	
-	-	-	Vine culture; food investigations.	
+	+	+	Inspection of foods and beverages; vegetable physiology; chemical technology.	
+	+	+	Agricultural technology, ...	Vegetation house; experiment field.
+	+	-	Animal physiology, ...	Pettenkofer's respiration apparatus; experiment stables, etc.
-	-	-	Vegetable physiology.	
+	+	-	Animal and vegetable physiology; experiments in stable and field.	Experiment stables; vegetation house; farm.
-	-	+	Vegetable physiology (water culture); seed investigations; microscopical studies.	Chemical and physiological laboratories; vegetation house; garden.
+	-	-	Feeding, vegetation and field experiments.	Vegetation house; horse dynamometer; stables; experiment field.
-	-	-	Investigations of wine, tobacco and other agricultural products.	
-	-	+	Vegetable physiology; diseases of plants, . .	Vegetation house; experiment garden.
+	+	+	Vegetation experiments; action of fertilizers.	
+	+	+	Scientific research.	
+	+	+	Field experiments with fertilizers; chemical technology.	

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§ Includes a branch station at Magdeburg, with a superintendent and one assistant.

|| Proceeds of sale of dairy products.

Statistics of the Agricultural Experiment Stations

DIVISIONS OF GERMAN EMPIRE.	LOCATION, CITY OR TOWN.	Date of Organization.	INCOME.				WORKING FORCE.			
			From Government.	From Agricultural Societies.	From Analyses, etc.	Total.	Directors.	Assistants.	Secretaries.	Janitors, servants, etc.
Mecklenburg-Schwerin.	Rostock,	1875	-	-	-	$7,000	1	4	1	3
Saxe-Weimar,	Jena,	-	-	-	-	750	(*)	3	-	-
Anhalt,	Coethen,	1864	$225	-	-	-	1	1	-	-
	Bernburg,	1882	-	-	-	5,775	1	4	-	1
Alsace-Lorraine,	Rufach,	1874	-	-	$800	3,665	1	2	-	1
Bremen,	Bremen,	1877	8,125	$100	2,025	10,750	1	7	1	-
	Stations outside the Association.									
Prussia,	Berlin,	-	-	-	-	37,500	2	7	-	-
	Berlin,	-	-	-	-	17,750	4	7	-	-
	Breslau (Institute for Animal Chemistry of the University).†	1869	787	-	-	-	1	2	-	-
	Breslau,	-	-	-	-	625	1	-	-	-
	Proskau (Royal Pomological Institute).	1873	375	-	-	-	1	1	-	-
	Proskau (Dairy Institute).	1878	2,250	100	-	-	1	1	-	-
	Arendsee,	-	-	-	-	-	1	-	-	-
	Magdeburg,	1885	-	-	-	-	1	3	-	-
	Göttingen (Agricultural Institute of the University).	1872	-	-	-	-	1	1	-	-
	Bremervörde,	1876	-	-	-	-	1	1	-	-
	Kempen,	1883	-	750	-	-	1	-	-	-
Bavaria,	Munich (Royal Technical High School).	1875	1,050	-	-	-	1	1	-	-
	Munich,	1874	-	-	-	-	2	7	-	-
	Weihenstephan,	1866	-	-	-	-	1	3	-	-
	Bayreuth,	1867	‡1	62	-	-	1	-	-	-
	Landshut,	1876	‡	25	-	-	1	1	-	-
Saxony,	Dresden (Veterinary School).	1862	750	-	-	-	1	1	-	-
	Döbeln,	1872	-	-	-	-	1	1	-	-
Würtemberg,	Hohenheim,	1877	525	-	200	-	1	1	-	-
Saxe-Meiningen-Hildburghausen.	Eisfeld,	1872	-	-	-	-	1	-	-	-
Hamburg,	Hamburg,	1891	-	-	-	-	1	-	-	-
Total,		-	$52,103	$7,927	$31,526	$153,928	76	151	5	17

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* Board of four professors.

† Transferred from Proskau in 1881.

of the German Empire, July, 1892 — Concluded.

INSPECTION.			Special Lines of Work.	Equipment.
Fertilizers.	Feeding Stuffs.	Seeds.		
+	+	+	Vegetable physiology; feeding experiments,	Vegetation house; stables; experiment field.
+	+	+	Chemistry; vegetable physiology	
+	+	-	Sugar-beet culture; feeding experiments.	
-	-	-	Vegetable physiology; sugar-beet culture,	Vegetation house; experiment field.
+	+	+	Vegetable physiology; vine culture; inspection of foods and beverages.	
-	-	-	Moor culture.	
-	-	-	Station of the union of manufacturers of alcoholic spirits.	
-	-	-	Station for beer manufacture.	
-	-	-	Animal physiology.	
-	-	+	Agricultural botany; seed control.	
-	-	-	Vegetable physiology, especially diseases of fruit trees.	
-	-	-	Dairying,	Laboratory; experiment dairy; collection of models, etc.
-	-	+	Seed testing.	
-	-	-	. . . .	Laboratory and experiment field.
-	-	+	Seed control.	
+	+	+	Scientific research.	
-	-	-	Agricultural physics and physiology,	Laboratory; experiment field.
-	-	-	Chemical station for beer brewing,	Laboratory.
-	-	-	Chemical station for beer brewing,	Chemical and bacteriological laboratories; experiment breweries; garden; fields.
-	-	-	Fertilizers; feeding stuffs; seeds; soils.	
-	-	+	Seed control.	
-	-	-	Animal chemistry, physiology and pathology.	
-	-	-	Physics and chemistry of fertilizers and soils; vegetation experiments.	
-	-	-	Seed testing.	
-	-	-	Chemical investigations of fertilizers, etc.	
-	-	-	Foods, fodders and seeds.	
29	27	34		

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‡ Income from both government and agricultural societies.

*Number and Distribution of the Agricultural Experiment Stations of the World, Complete to January, 1893.**

COUNTRY.	Number of Stations.
Germany,	67
United States of America,	55
France,	53
Austrian Empire,	35
Sweden,	24
Italy,	17
Russia,	14
Belgium,	9
Switzerland,	9
Denmark,	8
Great Britain,	8
Norway,	4
Holland,	4
Java (belonging to Holland),	3
Portugal,	3
Roumania,	2
Spain,	1
Brazil,	1
Japan,	1

It might not be out of place at this point to give a few statistics relative to the American stations.† In the United States, agricultural experiment stations are now in operation in all the States and Territories of the Union, according to act of Congress passed in March, 1887. The United States grant is divided in some States, so that several of the States contain two stations. In the States of Massachusetts, Connecticut, New Jersey and New York, a separate station is maintained entirely or in part by State funds, while in Louisiana a station for experimenting in sugar-cane culture is sustained entirely from the contributions of the sugar planters. We have certainly fifty-five agricultural experiment stations, receiving from the national and State governments and from private individuals, and for fees from analytical work, in round numbers, nine hundred and fifty thousand dollars. These stations employ officers engaged in different lines of work, as follows: directors, seventy; chemists, one hundred and thirteen; agriculturists, forty-seven; horticulturists, fifty; botanists, thirty; entomologists, thirty-six; veterinarians, twenty-two; meteorologists, fourteen; biologists, four; viticulturist, one; physicists, four; geologists, two; mycologists, three; microscopists, two; irrigating engineers, three; in charge of sub-stations, twenty-six; secretaries and treasurers, twenty-four; librarians, seven; clerks, nineteen. There are forty-three persons employed as farmers, superintendents, gardeners, etc.

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* Taken from die Landwirthschaftlichen Versuchs-Stationen, Heft III., 1892, compiled by F. Nobbe.

† See Experiment Station Record, February, 1892. Some slight changes have been since made, but not sufficiently important to seriously affect the accuracy of the above information.

The mailing lists now number some three hundred and fifty thousand names, and at a low estimate a total of forty million pages of reading matter upon different agricultural subjects have been circulated among the farmers during the past year. The stations are working substantially along the following lines: twenty-seven are studying meteorological and climatic problems; thirty-one are in various ways making a study of the soil; thirty-five analyzing commercial fertilizers and performing experiments in plant feeding; twenty-five stations are investigating the composition of feeding stuffs, and in some cases making digestion experiments; twenty-four are making experiments with reference to the production of beef, milk, mutton and pork, and studying different methods of feeding; at least thirty-three stations are studying the different methods of chemical analysis; botanical studies in different directions occupy a portion of the time of some thirty-three stations; thirty-five stations are at work upon different horticultural problems; and at least twenty-five stations are pursuing investigations relative to injurious insects, with a view to preventing their ravages; four stations are giving attention to apiculture; three to aviculture; and six stations are engaged upon problems in sugar production.

Differences between German and American Stations.

The Germans are in advance of us, in that they not only subject commercial manurial substances to a critical inspection, but *commercial feed stuffs* and *various seeds* as well. It is earnestly to be hoped that those who are guarding the farmers' interests in Massachusetts will see that suitable laws are speedily enacted to regulate the sale of commercial feed stuffs, and thus protect the farmer and every other man who keeps a horse or cow or pig.

The laws governing the trade in the various fertilizers and fodders are somewhat different in different sections of Germany. As a rule, every man who buys a certain quantity of fertilizer or grain has the privilege granted him of sending a sample of the goods purchased to be analyzed at the station. Sometimes the local dealer is allowed to do this by the manufacturer; at other times the cost of analysis is borne by the local dealer himself. Very often large dealers and manufacturers make contracts with experiment stations, whereby they are allowed to have a certain number of analyses made for a specified sum. Many of the stations encourage the farmers to club together and purchase their goods in large quantities from first hands, thus saving money, and at the same time securing goods fully up to the guarantee. These methods of control have their advantages, in that they bring the farmer into close connection with the station, and cause him to pay attention to *guarantee* and *general composition*, as well as to price. It would seem, on the other hand, to leave in a large measure the small farmer unprotected.

When the German investigator has obtained results of value, he publishes them as a rule in one of the numerous scientific agricultural journals in which the German language abounds. He is bound by no law in the matter, the articles are in scientific language, and I fancy but few other than scientific men, broadly educated agriculturists and agricultural editors, read them. Very often a synopsis of the work accomplished is presented in popular form in the local agricultural papers. Here I think we in many respects have better methods. The Massachusetts State Experiment Station, for example, by means of its bulletins, sends information directly into the homes of ten thousand Massachusetts farmers. Still, I believe our American stations have not even yet reached perfection. I have often thought that many of the bulletins published by the different stations were just scientific enough to blind the farmer, and not nearly complete enough in data to enable scientific men to determine whether anything had really been proved, or not.

I have said that the German is in a sense a specialist, in that he confines himself to fewer lines of inquiry, and studies them more fully. He devotes himself, perchance, to a single subject for years, uses all the methods that science has placed at his command, and by and by out of this abstract research one hears the cry, *Eureka!* and agriculture is advanced a step.

I have said, further, that our German brother has no law compelling him to publish results every three months, whether he has any results to publish or not. Here, I believe, is one of the weaknesses in our American stations. There is a great pressure upon them all the time for results. Give us some *practical* results, cries the farmer, and give them often; just as though the experiment station worker had but to turn the crank and grind them out! The result of this demand is to cause a great deal of inferior work to be done, that can be of no permanent value. Gentlemen, remember that when you ask a man to investigate problems in the animal or vegetable world, it is no easy task that you have given him to do. Do not criticise him for being scientific, and declare that you want only practical men. If to comprehend the laws governing the nutrition of that wonderful piece of machinery, the animal body; if to understand the anatomical structure of the plant, the physiological meaning of its various organs, and its most economical nutrition — does not require the aid of about all the science that the best of us are able to command, then I am entirely mistaken. Far be it from me to decry men of good, hard common sense, — practical men, if you will; but I do plead in addition that they possess a thorough scientific training. Let me illustrate. You enter a large dry goods store, and see perchance spread out before you a great variety of silks of the most beautiful shades of color. You ask, How is it possible to obtain such a great variety, such a wealth of color? I will tell you. It is a triumph of science. When that great chemist, the late A. W. von Hoffman, with his wonderful chemical knowledge, discovered the aniline, all that was made possible.

Gentlemen, if you, as progressive agriculturists, carry away but one thought with you to-day as a result of our talk, let it be this: If our experiment stations in the United States are to be successful, in that they are to bring to light knowledge that is to be of permanent value to agriculture, that knowledge must be obtained through men who have the *scientific training* as well as the *time* necessary for investigation.

II.

WORK OF SOME OF THE GERMAN STATIONS.

I now ask your attention to a more detailed study of some of the work recently accomplished, or now in progress, at several of the German stations. I have selected for our consideration four stations that I believe are now engaged in important agricultural research: namely, the station at Göttingen, directed by Professor Lehmann, the successor to the late Professor Henneberg; the Halle station, under the supervision of Professor Maercker; the station at Bernburg, directed by Professor Hellriegel; and, finally, the one at Darmstadt, conducted by Prof. Paul Wagner.

A. EXPERIMENT STATION AT GÖTTINGEN.

The experiment station at Göttingen, in the province of Hanover, was established June 3, 1857, with Dr. Henneberg (afterwards Professor Henneberg) as its director, a position which he held till his death, in November, 1890.

Its principal work has ever been — and for the last twenty years exclusively — the study of the problems of animal nutrition. The work accomplished has given the name of Henneberg a world-wide reputation. When Henneberg began his investigations, very little was known concerning the laws governing the feeding of domestic animals. The so-called "hay value" theory of Thaers was then in vogue, but when put into practice it led oftentimes to exceedingly unsatisfactory results. For example, hay was held to be the normal or standard fodder for farm animals; and it was attempted, by means of equivalent numbers, to compare the value of all feed stuffs to hay. This was accomplished by very simple chemical analysis, in that the portion soluble in water, dilute acid and alkali was held to be the amount valuable as food for the animal. The results obtained by this method were arranged in tables. An improvement were the tables compiled by Boussingault, in which fodders were compared by the amount of nitrogen they contained. Wolff went a step further, in that he divided the fodder components into two great groups,—the nitrogen-containing substances, and the nitrogen-free matter. So far had our knowledge progressed when the Göttingen station began its work. After making some experiments disproving the "hay theory," Henneberg adopted a plan which has virtually been followed at the Göttingen station ever since; namely, (1) resolve the fodders into their chemical constituents, as Liebig had already attempted, and (2) follow these different groups of constituents through the changes they undergo in the animal body, in a similar way as Bischoff and Voit were doing with carnivorous animals at Munich.

1. *Chemical Methods.* (*Weender Method.*)

Liebig recognized three groups of nutrients in fodders: viz., albuminoids (nitrogen-containing substances), fats, and carbohydrates (sugars, starch, gums, etc.); and later a fourth group was admitted, namely, the cellulose. The methods for determining these substances were at first crude, and when it was attempted to tabulate results and secure averages, it was found that the percentages differed so much that they were of very questionable value. Henneberg, aided by his assistants, made a critical study of these methods, made many improvements, and finally established the so-called Weender method, which, with very slight changes, is still employed in all the agricultural laboratories of the world. He divided the fodders into four great groups of constituents, and called them crude cellulose, crude fat, crude protein and nitrogen-free extract matter. It was known at that time that the method was by no means perfect, and our information concerning plant composition to-day enables us to detect many additional weaknesses; but, until our knowledge of the composition of plants is still further increased, it will continue to be the method employed by all investigators.

2. *The Establishment of Digestion Coefficients.*

Holding fast to the work already accomplished, viz., the perfection of chemical methods for determining the four groups of fodder constituents, we have still not entirely accomplished our object; for a nutrient is not that portion determined simply by chemical analysis, but rather *that portion of the group which the animal is capable of digesting*, which goes to the sustaining of the vital forces and to the production of bone, flesh, and fat. An experiment to determine digestion coefficients, briefly described, is as follows: We first analyze the fodder to be fed, determining the percentages of cellulose, fat, protein and extract matter it contains. Then we feed a certain weighed quantity of this food and subject the portion that is undigested, *i. e.*, the solid excrements, to the same analysis. Knowing now the percentages contained in the fodder before it was consumed, and also the percentages undigested, the difference between the two will give us the digested percentages, or digestion coefficients. Of course there are many details to be observed, and care to be taken, in order to obtain correct results, which the worker alone can understand. Henneberg carried on these experiments first with oxen and afterwards with sheep, and they have been continued at this station even up to the present time. Digestion experiments were afterwards taken up by many other stations in Germany, and when a sufficient number had been completed, Professor von Wolff brought them together into the so-called Wolff's tables, published every year in Mentzels and Lengerke's * agricultural calendar, and used in all quarters of the world. Let me now give you a practical example. How much digestible material will twenty pounds of average English hay contain?

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* Julius Kühn has also published similar compilations in his book entitled "Die Zweckmässigste Ernährung des Rindviehs" (the most correct way to feed farm stock).

English Hay (free from Moisture).

	Percentage Composition.	Twenty Pounds contain in Pounds.	Percentage Digestible.	Amount Digestible in Pounds.
Crude ash, ...	6.17	1.23	–	–
Crude cellulose, ...	31.90	6.38×	58 =	3.70
Crude fat, ...	2.30	0.46×	46 =	0.21
Crude protein, ...	9.60	1.92×	57 =	1.09
Nitrogen-free extract, ...	50.03	10.01×	63 =	6.30
Per cent, ...	100.00	20.00	–	11.30

We find that twenty pounds of perfectly dry hay contain 11.3 pounds of digestible matter.

How to find the Nutritive Ratio.

By nutritive ratio is meant the proportion of the protein (or nitrogenous part) to the non-nitrogenous part (cellulose, fat and extract stuff).

It has been found by experiment that *fat* furnishes 2½ times as much vital energy as the cellulose and extract stuff, and it is therefore multiplied by 2½ in calculating the nutritive ratio.

20 pounds of hay contain :—	Pounds.
Crude cellulose digestible, ...	3.70
Crude fat digestible, .21 pounds × 2.5 = ...	.53
Extract matter digestible, ...	6.30
Total non-nitrogenous portion digestible, ...	10.53

Non-nitrogenous.	Nitrogenous Portion (Protein).
10.53 ÷	1.09 = 9.66.

Nutritive ratio is as 1 is to 9.66, or 1 : 9.66.

3. *The Relation of the Fodder to the Processes of Digestion and Assimilation.*

With two facts already established, namely, (1) how to determine by chemical analysis the different groups of fodder constituents, and (2) the amount of these constituents digested, the next step was, if possible, to find out what became of the digested portion of the food, and consequently to ascertain the laws governing the production of flesh and fat. Among the questions to be answered were these: (1) What becomes of the digested portion in its relation to the production of lean meat and fat? and (2) Is there any way to feed so that flesh and fat can be produced at will? and further, How shall animals be fed so as to get the greatest returns for food consumed?

As early as 1858–60 the celebrated physiologists Bischoff and Voit had published the results of their investigations relative to the movements of the nitrogenous compounds on carnivorous animals (dogs and cats). They overthrew the theory that nitrogen in any form was exhaled through the lungs or skin, and proved conclusively that the only nitrogen given off by the animal was to be found in that undigested portion, the solid excrements, and in the end product of nitrogenous decomposition, the urea of the urine. By finding the difference between the amount of nitrogen in the food consumed and the amount given out in the solid and liquid excrements, it could be ascertained whether or not the animal had put on or lost nitrogen, and hence put on or lost flesh or lean meat. This discovery was confirmed on steers and sheep at the Göttingen station. Here, then, we have *a method* for determining the loss or gain in lean meat; for 100 parts of dry flesh contain about 16 parts of nitrogen, and 100 divided by 16 gives us the factor 6.25. Now, by multiplying the percentage of nitrogen gained or lost by 6.25, we calculate it to dry flesh, and this can be easily reduced to moist or natural flesh.

To determine the production or non-production of fat, the case was not so easy, but still a way was found. Professor Pettenkofer of Munich invented the so-called Pettenkofer respirations apparatus, by the use of which one is enabled to estimate the amount of gaseous exhalations given off by animals. Living beings exhale, as a result of the decomposition of food consumed, carbondioxide (CO^2) and water (H^2O) through the lungs, and many farm animals a considerable quantity (as high as ten per cent) of marsh gas (CH^4) through the skin and vent. If, now, the amount of carbon can be measured in these gases, it is possible to obtain by calculations the amount of fat gained or lost in the animal body. This respirations apparatus, for large animals, to be brief, consists of a small room, size eleven feet by eight feet by seven feet, with the walls made of iron, and quite air tight, with an inlet to allow the fresh air to enter. The animals to be experimented upon are placed in this room for twenty-four hours, and in the case of two sheep fifty cubic meters of air are drawn through per hour. The air *before* it enters, and likewise after it has passed through the room and contains the gases breathed out by the animals, is constantly sampled and analyzed, the carbon of the carbonic acid and marsh gas being accurately estimated. The carbon multiplied by the factor 1.3 gives the percentage of fat. Now, if the per cent and amount of carbon is determined in the food consumed, and the amount of this element is also determined in the solid and liquid excrements, and in that portion given off as gas just referred to, the amount left over, if any (after allowing for that needed by the albuminoids), multiplied by 1.3, represents the amount of fat put on by the animal during the twenty-four hours' experiment. If none is left over, but the amount of carbon taken in and given out is equal, then there has been no production or loss of fat; while, if the amount of carbon given out is larger than the amount consumed, then fat has been actually lost. A simple illustration will make this plain: —

	Grams Carbon.
A sheep consumed during twenty-four hours hay and grain containing carbon,	437.17
This carbon was given off as follows: —	
Carbon given off from lungs and skin,	239.25
Carbon given off in solid excrements,	136.00
Carbon given off in liquid excrements,	19.83
Carbon in lean meat put on in twenty-four hours,	7.33
Total,	402.41
Carbon consumed,	437.17
Carbon given off or put on in flesh,	402.41
Amount of carbon remaining,	34.76

34.76 C × by factor 1.3 (to reduce to fat) = 45.19 grams dry fat put on in twenty-four hours.

But I imagine some of you saying that I am taking you into purely abstract research, and that you do not see just how such investigations can help the farmer. Gentlemen, I believe that work of this kind is helping and eventually will help the farmer, perhaps even more than many of us dream of. I have thought it best to call your attention to this line of work, in order that you, as progressive agriculturists, might see how closely, how deeply, how scientifically, if you please, this problem of animal nutrition, of fat and flesh production, is being studied by a German experiment station. I have no time to describe to you the many discouragements met with, and the many years of patient investigation necessary, to enable these investigators to get thus far towards solving the problems of animal nutrition.

If you will allow me very briefly to recapitulate, I think I can show you a record of progress made: (1) Methods established for the analysis of the food consumed; (2) The amounts of *digestible matter* in the foods determined; (3) Methods discovered and perfected to ascertain what becomes of this digested food, and consequently as a result to accurately determine the gain or loss of fat and lean meat in the animal body. With these methods in hand, the problem the Göttingen station is now studying is how to feed the different foods, in what proportions we shall feed our protein and carbohydrates, in order to feed them most economically, in order to find out if possible how to put more lean meat and not so much fat on animals intended for beef, or, if you will go a step further, how to produce flesh and fat at will. Investigations thus far made with the respirations apparatus indicate that we must feed more protein, *i. e.*, narrower fodder rations, in order to produce beef with the greatest economy. Still, the investigations have not progressed far enough to enable us to draw any very certain conclusions.

I will not speak to you of other methods that have been suggested, tried, and are now being used with more or less success to aid in solving the problem of economical beef production. As yet we are not at all clear, when we feed, what we produce, whether it is flesh, fat or water. The scale tells us whether an animal increases or decreases in weight; but, in case of an increase, whether that animal is putting on lean meat or fat, or storing up a very watery beef, it gives us no insight. For example, experiments with the respirations apparatus have shown that an animal may for weeks be gaining constantly in fat, and still the scale not show an increase, in that water was being displaced and fat put on in its place. I think you will agree with me, gentlemen, in saying that it will be greatly to the advantage of the farmer, and to mankind in general, when we know more about the *laws* that govern the growth and nutrition of the live stock of the farm.

B. The Halle Experiment Station.

The agricultural experiment station of the Agricultural Society of the Province of Saxony was moved in 1868 from Salzmünde to Halle, and is at present under the direction of Prof. M. Maercker, who is also professor in the University of Halle. This station has also a branch at Magdeburg, established in 1889. Its work can be summed up as follows: —

1. Work in the chemical laboratory, in the examination of fertilizers, fodders, soils and general agricultural analysis.
2. Work in the botanical laboratory, in the examination of seeds, fodders, study of plant diseases, etc.
3. Investigations concerning sugar-beet culture and alcohol manufacture.
4. Feeding experiments with animals.
5. Field experiments with various agricultural plants.
6. Investigations into the growth and food requirements of agricultural plants by means of pot experiments.

In order that we may understand to what an extent the work in the chemical laboratory is carried on I present here the number of analyses made in the years 1888, 1889, 1890 and 1891: —

	1888.	1889.	1890.	1891.
Fertilizers and soils,	2,667	3,067	3,223	3,495
Fodders and sugar beets,	895	1,094	1,147	1,301
Botanical laboratory,	502	656	966	1,145
Soils for phosphoric acid,	–	–	303	141
– – –	155	436	200	–
Fodders in feeding experiments,	712	819	661	125
Sugar beets (special),	442	144	6	391
Plant analyses (pot experiments),	–	–	313	713
Total,	5,373	6,216	6,819	7,311

Branch Station at Magdeburg.

	1890.	1891.
Fertilizers,	397	407
Fodders and milks,	1,924	2,137
Total,	2,321	2,544

When it is considered that in many or most of these substances analyzed, different ingredients were determined, and that parallel tests must always be made, one can see that the work involved is indeed very great. To carry forward this work of the station in its various branches the following help is employed: —

Director,	1
Assistant director,	1
Chemists,	8
Chemical assistants,	2
Botanists,	2
Secretary,	1
Book-keeper,	1
Gardeners,	2
Laboratory helpers,	5
Total,	23
Chemists at Magdeburg,	3
Total,	26

This station is by far the largest of its kind in the world, and is situated in a most fertile agricultural region, where a very intensive system of farming is pursued.

It would be impossible, in the very limited time at my disposal this afternoon, to attempt to speak very much in detail relative to the experiments carried on at this station; but in passing I wish to touch briefly on some experiments carried out a year or two ago in feeding farm animals, viz., milch cows, fattening steers and sheep.

First, I might say that this station has no stables for its feeding experiments, but that they are carried on under the supervision of the station by intelligent farmers. The station lays out the plan, analyzes the fodders and milk, and has a general oversight of the experiments during their continuance.

The experiments above mentioned,* undertaken for the study of questions of local importance, are of more than local interest, and have attracted considerable attention in Germany.

In the region about Halle large quantities of sugar beets are raised, and the diffusion residue, or beet pulp, remaining behind after the sugar has been extracted, is a very important feeding stuff. The manufacture of alcohol from potatoes is conducted upon a large scale on many farms, and the potato residue is also an important factor in the feeding. The objects of the experiment were: (1) to find out how much of the watery food could be fed to advantage; (2) to ascertain if more liberal rations than the current feeding standards (such as Wolff's) call for, namely, 2.5 pounds digestible protein, 0.5 pound fat and 13 pounds carbohydrates, might not be profitable; (3) it was desirous of testing more thoroughly the influence of the relation of the nitrogenous to the non-nitrogenous matter in the food, or, in other words, the old question of wide or narrow rations. The foods fed were hay, straw, pea-straw, lupines, corn meal, barley meal, wheat bran, cotton-seed meal, peanut meal, palmnut meal, poppy-cake, and the residue of sugar beets and potatoes.

Several experiments were made with herds containing eight to eleven milch cows and steers, and with flocks of thirty sheep, in lots of ten each.

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* For a very excellent resumè of these experiments see Experiment Station Record, March, 1892.

Results. — It was found (1) that as high as 80 to 90 pounds of beet refuse could be fed to advantage, giving a total water consumption in the food of 100 pounds; (2) the increase in watery food was without discernible effect upon the *composition* of the milk; (3) the quantity of milk increased regularly, with the increase of beet residue fed; (4) all the highly nitrogenous rations, for example, those with as high a content of digestible protein as 3.5 to 4 pounds per day, per head of cows and oxen, and per 1,000 pounds of sheep, with a nutritive ratio of 1 : 4 to 1 : 4.5, proved profitable, while all the rations with a large amount of non-protein gave financially unfavorable results.

The general conclusions were: (*a*) an excess of carbohydrates and fat is always to be avoided in feeding, whether for milk or fattening; (*b*) there is no objection to feeding considerable more protein than current usage and feeding standards call for (*i. e.*, 2.5 pounds per day); (*c*) the advantage rests partly in the increased production and partly in the increased value of the manure.

C. The Experiment Station at Bernburg.

The experiment station at Bernburg in the dukedom of Anhalt was established in 1882, with Prof. H. Hellriegel as director, who is engaged in studying the effect of different forms of plant food upon sugar beets and upon the cereals. It was while engaged in this work that Professor Hellriegel and his assistant, Dr. Wilfarth, established for themselves a world-wide reputation among scientific men by proving conclusively the fact that the leguminous plants, such as the clovers, peas, beans, lupines, etc., could assimilate the free nitrogen of the air.

The question as to whether or not plants were capable of drawing upon the free nitrogen of the air for their supply had been disputed for many years by scientific men. Among the ancient Romans, for example, it was recognized, according to Pliny, that the legumes made a luxuriant growth without the aid of manure. As early as 1780 Priestley and Tugendhauser thought that they had proved that plants could appropriate atmospheric nitrogen; but Sausseur in 1804 disproved Priestley's work. At the beginning of this century Thaer observed that leguminous crops seemed to leave the land in better condition, and he thought it very probable that the nitrogen was obtained from the air, and that it was set free from the roots in the process of decay. Between 1830 and 1850 Monsieur Boussingault made an exhaustive study of this subject, and finally came to the conclusion that plants could not utilize the atmospheric nitrogen. Lawes and Gilbert, assisted by Dr. Pugh, repeated these experiments very shortly afterwards, and came to the same conclusion. Boussingault, however, observed that, after his experiment plats could no longer produce a crop of grain by reason of their lack of nitrogen, by growing leguminous crops for a year the land became sufficiently improved to enable him to obtain another average grain crop. For example, he planted a certain area of land with a different crop each year during five consecutive years, and removed each year the following kilograms of nitrogen from the soil: —

YEAR.	Crop.	Nitrogen removed.
1, ...	Potatoes, ...	47.2
2, ...	Wheat, ...	26.9 9.2
3, ...	Clover, ...	86.4
4, ...	Wheat, ...	33.2 11.4
5, ...	Oats, ...	23.6 5.2

Lawes and Gilbert also confirmed these results, and both French and English investigators concluded that it was not necessary to apply nitrogen-containing manures to leguminous crops, *because these plants were enabled by their penetrating roots to draw their supply from the lower strata of soil.*

Schulz-Lupitz, a very intelligent farmer of Saxony, some ten years ago called attention to a large number of experiments made by himself with leguminous crops.

He planted first a grain and then a leguminous crop, manuring only with potash and phosphoric acid, and succeeded in every case in obtaining a good average crop of grain. He felt convinced that the leguminous crops took their nitrogen from the air, and spoke of the root nodules they contained.

With this brief historical description, let us return to Professor Hellriegel's* work. In the year 1886, at a meeting of German agricultural experiment station workers at Bremen, he brought forward the results of several years' experiments, and proved conclusively, for the first time, that the legumes were actually capable of utilizing the free atmospheric nitrogen.

By way of illustration, I present here a very brief outline of how his work was carried out: —

In one series he cultivated both legumes and grains in pots containing pure sand. Both pots and sand were previously heated very hot, to destroy any nitrogen-containing organic matter, and all germ life. These plants only grew to a certain height, and then turned yellow and gradually died, though they were supplied with all the fertilizing ingredients necessary to their growth *except* nitrogen. The plants and roots, both carefully collected, weighed and analyzed, were found to contain only the amount of nitrogen contained in the seeds.

In a second series he omitted to sterilize the sand and pots. After the grains and lupines had used up all the nitrogen of the seed, their leaves turned yellow and they began to dry up. Suddenly, within two or three days, it was observed that the leaves on some of the *legumes* became a bright green again; the plants began to grow rapidly, and finally blossomed and produced seed. Little nodules were also observed on the roots, and it was noticed that these nodules began to appear at the same time that the plant began its second growth. The grains in this series turned yellow after they had used up the nitrogen in the seed, and did not recover themselves.

In a third series both the grains and the legumes were inoculated with a soil extract, obtained by shaking some of the soil on which leguminous crops had previously grown, with water. The leguminous crops, after they had consumed all the seed nitrogen, began to turn yellow, but very soon recovered themselves, turned green, grew most luxuriantly, and reached a full maturity. The grains, after having exhausted the seed nitrogen, died in every case. It was observed, however, that, when the soil extract was first heated to 70° C , before being applied, it had no effect. It was further noticed that an extract made from soil taken from land on which legumes had not been grown for a long while was quite often without any effect. The following analysis, as an example, shows one of the results obtained : —

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* Hellriegel's original work can be found in the Beilageheft zur der Zeitschrift des Vereins f. d. Rübenzucker-Industrie d. D. R., November, 1888.

PLANT.	Nitrogen in Seeds.	Dry Matter harvested.	Nitrogen in Dry Matter.
	Grams.	Grams.	Grams.
Yellow lupine, ...	0.0258	40.574	1.0749
Yellow lupine, ...	0.0258	42.681	1.1684

When the legumes were manured with nitrogen, Hellriegel found that they were perfectly able to appropriate the nitrogen applied, and while root nodules were noticed, they were by no means so abundantly developed as when nitrogen was not applied.

Professor Hellriegel therefore concluded that the leguminous plants were capable of drawing their nitrogen supply from the air, while, on the other hand, the grains and non-leguminous crops generally had not this power. Further, that the legumes were enabled to do this because of the development of the so-called root tubercles, and that certain micro-organisms of the soil were in some way the cause of the tubercle development. Hellriegel's results were afterwards confirmed by many other investigators, especially by Prazmowski,* who, in very carefully conducted experiments, where every precaution was used, proved beyond a doubt that the nitrogen obtained by the plants came from the air.

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* Die Wurzelknöllchen der Erbse (Landw. Versuchsstation, Bd. XXXVII, 1890, p. 161, and Bd. XXXVIII, 1890, p. 1).

Professor Beijerinck [*] of Amsterdam first succeeded in isolating the bacteria that produced the root nodules, and called it *bacterium radicicula.* Prazmowski succeeded in isolating the bacteria shortly afterward, and has given us a great deal of information relative to its life history and its relation to the root tubercles.[†]

The work at the Bernburg station accomplished by Professor Hellriegel is therefore a very important one. The farmers the world over, nay, all mankind, are, I believe, greatly indebted to the patient investigator, the modest gentlemen, Professor Hellriegel, and to his able assistant, Dr. Wilfarth.

The fact once confirmed, viz., that the leguminous plants are capable of utilizing atmospheric nitrogen, the questions that would naturally arise would be the following: (1) can the results obtained in a small way, by means of pot experiments, be applied in practical farming? and, (2) if they can, ought any nitrogen whatever to be used in growing leguminous crops? While I confess to be going rather outside the limits of my subject, I wish, however, to present the general European opinion in as few words as possible. In answering the first question, I will give you an account of an experiment that is being tried by a practical and well-informed farmer in southern Germany.[‡] The farm in question had been used formerly for milk production. The entire stock of animals was disposed of, and the proprietor turned his attention to growing grain, sugar beets and potatoes, depending upon the leguminous crops for his entire supply of nitrogen. The soil was an average loam, fairly rich in lime. The system pursued was as follows: immediately after harvesting the grain, peas and vetch were sown broadcast on the ploughed stubble, at the rate of 180 pounds per acre, and the green crop ploughed under in the late autumn or early spring. Clover was also grown between the rows of grain, and ploughed under after the latter was harvested. Both of these methods succeeded, and Dr. Dehlinger, the owner of the farm, is growing grain, beets and potatoes to-day, without applying any nitrogenous fertilizer whatever. It was calculated in 1890, a year very favorable to the development of leguminous crops, that as high as 250 pounds of nitrogen per acre was obtained from the crop of vetch and peas. This, of course, could by no means be expected every year.

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[*] Botanische Zeitung, No. 48, November, 1888, Die Bac. der Papilionaceen Knöllchen von M. W. Beijerinck.

[†] For a very excellent résumé of the work thus far accomplished in this direction, the interested reader is referred to a review by Prof. H. W. Conn, in the Experiment Station Record, June, 1891, p 686, and August, 1891, p. 56; also to a résumé of F. Nobbe's work, *ibid.*, p. 336.

[‡] See Die Stickstoffdüngung der Landwirthschaftlichen Kulturpflanzen I Theil von Prof. Dr. Paul Wagner, 1892, p. 282.

This experiment, in a measure, answers the second question, namely, Is it advisable to apply any nitrogen whatever to leguminous crops? Still opinions differ, and no exact answer to cover all cases can as yet with certainty be given. In fact, I am inclined to believe that circumstances, such as climate, soils, etc., will control the case. Let me illustrate: When a leguminous crop is planted upon land poor in nitrogen, it grows well during its earlier stages, till it has exhausted all the available nitrogen of the soil. It then begins to turn yellow, and shows unmistakable signs of nitrogen hunger. Suddenly the leaves begin to turn green again, and rapid growth takes place, because the root nodules have begun to develop, and consequently the nitrogen to be assimilated. Now, the critical period is when the soil-nitrogen becomes exhausted, and before the plant can get hold of the air-nitrogen. European experience has quite often recommended that in certain cases where, for example, the crop appears especially backward, or if the weather is bad, 30 or 40 pounds of nitrate of soda be applied, per acre, to tide the crop over the critical stage.

Experiments made by Professor Goessmann at the State Experiment Station this year were quite instructive. On plats of one-tenth of an acre each, that had received a liberal dressing with nitrogen, as well as potash and phosphoric acid, 2,000 pounds of green soja beans were raised; while on an equal area, with land in the same condition, where no nitrogen was used, the yield was but 1,400 pounds. So far as the writer noticed by an examination of the roots of the bean, the nodules were but comparatively few in number; and this result, according to his individual opinion, might be attributed to a scarcity of the soja bean bacteria in the soil. We have yet many experiments to make before a fuller knowledge can be obtained.

D. The Darmstadt Experiment Station.

The fourth and last of the German stations to which I wish to call your attention is the one at Darmstadt, under the direction of Prof. Paul Wagner. This station is engaged in fertilizer and fodder control, and in investigations of problems in plant feeding. This investigator made ordinary field experiments upon measured plats of land at first; but, after a thorough study of this method, he came to the conclusion that to solve many of the problems in plant nourishment it was not practicable. His reasons therefor, briefly stated, are the following: * —

1. It is very difficult to find a field or portion of a field where the soil is so uniform that, without manure, each plat will yield practically the same quantity.

2. The selection and measuring of the plats, the manuring and seeding of the same, as well as the harvesting of the crop, is a work of great difficulty, wherein many mistakes can be easily made, and where exact work is well-nigh impossible. When experiments are conducted upon a large number of plats, the work must be done by different workmen, and it is therefore impossible to have the various operations conducted in the same way.

3. Injuries, varying in degree, are caused on the different plats by insects, birds, mice, etc.

4. The increase in the yield caused by a manure is often too small in *proportion to the errors* in the experiment. The *difference in the yields* of the plats unmanured is often larger than the yields of the manured and unmanured plats.

5. In field experiments, one is too dependent upon the differences in condition of the soil and subsoil, and upon excess or lack of moisture; in other words, it is impossible

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* For a thorough discussion of the subject of field *vs.* pot experiments see "Beiträge zur Ausbildung der Düngungslehre," von Paul Wagner. "Landwirthschaftlicher Jahrbücher, 1883," and "Die Stickstoffdüngungen der Landwirthschaftlichen Kulturpflanzen," von Prof. Paul Wagner.

to control the many conditions sufficiently to draw accurate conclusions from the results obtained.

6. When one series of experiments is completed, it will require years to bring the plats into condition suitable for another series.

7. It is impossible to *establish the laws of plant nourishment* by means of results obtained from field experiments.

The field experiment has its place, however. It should give us information concerning local conditions, concerning the characteristics of various soils which ought to be ascertained, in order to get the most value from what science has taught. On the other hand, it is the duty of the investigator to study the *workings of the different fertilizers, when the experiments are entirely beyond the control of all local influences and conditions.*

Believing, therefore, that results could be more quickly and more accurately obtained in another way, this investigator, some eight years ago, turned his attention to the so-called pot experiment. He now uses pots made of tin, which are placed upon platform cars. These cars set upon iron tracks, and can be run under cover in case of a severe storm. The pots vary in size from six to twelve inches in diameter, and from nine to fifteen inches in depth. They are filled with about an inch of gravel, and then with the thoroughly mixed soil. A small tube extends down along the side to the bottom of the pot, to conduct the water below, instead of pouring it on the surface. The latter method of watering renders the soil too compact. The fertilizers are accurately weighed out in the laboratory, and carefully applied by either the professor or by a trusted assistant. Large iron cylinders, varying in size from a keg to a barrel, open at both ends, are sunk in the ground and filled with thoroughly mixed soil, and are used for large growing plants.

The soil is previously prepared by subjecting it either to a general or partial exhaustion.

When the writer was at the Darmstadt station, a year ago, Professor Wagner had some 1,100 to 1,200 pots in operation. The professor states that by this method he can make a very much larger number of experiments than by the ordinary field method; and, from the fact that all the circumstances can be controlled, they give far more accurate results.

Professor Wagner's work has been translated into English, French, Italian and Norwegian.

He discredits the use of the ordinary so-called complete or mixed fertilizer, from economical as well as scientific reasons, believing that we have, to an extent at least, passed beyond that stage in the science and art of manuring.

Let me, by a simple illustration, show you how an experiment is made to prove a certain point. Suppose we wish to compare the relative value of nitrate of soda and sulphate of ammonia. A soil is selected that is poor in nitrogen; phosphoric acid and potash are applied in sufficient quantities. The following table shows the remainder: —

Oats.

NITROGEN IN FORM OF—	Grams applied.	YIELD, DRY MATTER (GRAMS).		Total Dry Matter, Straw and Grain.	Excess over yield of no manure pots. Grain and Straw.
		Straw.	Grain.		
Not fertilized, . .	0.000	39.3	25.1	64.4	–
Nitrate of soda, . .	2.544	176.9	125.8	302.7	238.3
Nitrate of soda, . .	5.088	228.6	183.5	412.1	347.7
Sulphate of ammonia, .	2.544	134.6	99.6	234.2	169.8
Sulphate of ammonia, .	2.588	177.3	151.5	328.8	264.4

If we let 100 represent the amount yielded by the soda nitrate, then 71.3 and 76 represent the yield obtained with sulphate of ammonia. This is very low in this special case, as their relative value (see below) has been proved to be as 100 to 90.

In closing, I ask your attention to some of the results that Professor Wagner claims to have proved or confirmed. Lack of time prevents me from entering at all into detail.

Nitrogen.

(*a*) He has subjected the results obtained by Hellriegel to a very critical test, and concludes that all leguminous crops and only leguminous crops have the power to take their nitrogen supply from the free nitrogen of the air.

(*b*) The legumes will utilize the *soil-nitrogen* in preference to the air-nitrogen, providing they have the opportunity.

(*c*) Generally speaking, it is not advisable to apply any nitrogen to aid in the growth of leguminous crops. There are, however, exceptions, as, for example, on sandy soils very poor in nitrogen. In such a case the crop at a very early stage in its growth begins to manifest its hunger for nitrogen. If at that period 30 to 40 pounds of soda nitrate are applied per acre, this nitrogen-hunger will be relieved, and the plant becomes stronger and better able to exist till the bacteria co-operate with it in supplying the nitrogen needed.

(*d*) The grains in the following order, viz., barley, wheat, rye and oats, have the greatest need of soluble nitrogen, such as nitrate of soda and sulphate of ammonia, because of their short growing period; while roots, late potatoes and grasses, having a longer period of growth, can use the slower acting forms of nitrogen, such as stable manure, tankage, bone nitrogen, etc., to better advantage.

(*e*) The following figures, which must not be too literally construed, may prove interesting to some: —

To produce —

100 pounds oats with straw requires 24 pounds Chili saltpetre.
100 pounds wheat with straw requires 32 pounds Chili saltpetre.
100 pounds rye with straw requires 32 pounds Chili saltpetre.
100 pounds barley with straw requires 25 pounds Chili saltpetre.
1,000 pounds potatoes with tops requires 28 pounds Chili saltpetre.
1,000 pounds sugar beets with tops requires 16 pounds Chili saltpetre.
1,000 pounds fodder beets with tops requires 19 pounds Chili saltpetre.

From the above figures it can be calculated that 100 pounds of Chili saltpetre will produce, in round numbers: —

400 pounds oats with straw.
300 pounds wheat with straw.
300 pounds rye with straw.
400 pounds barley with straw.
3,600 pounds potatoes with tops.
6,400 pounds sugar beets with tops.
5,500 pounds fodder beets with tops.

(*f*) In order that the plant use the costly nitrogen to advantage, it should be well supplied with potash and phosphoric acid.

(*g*) The following table shows, in a general way, the amount of nitrogen to be applied per acre, the present condition of the land and its previous treatment being considered: —

	Nitrogen per Acre.	Corresponding to Chili Saltpetre.	Corresponding to Sulphate Ammonia.
	Pounds.	Pounds.	Pounds.
Grains, ...	13–53	88–352	66–264
Potatoes, ...	22–44	140–285	110–220
Sugar beets, ...	22–53	140–352	110–264
Fodder beets, ...	26–66	176–440	132–352
Tobacco, ...	13–26	88–176	66–132
Grape-vines, ...	13–26	88–176	66–132
Fruit trees and bushes, ...	26–53	176–352	132–264
Cucumbers, squashes, asparagus and strawberries, ...	22–53	140–352	110–264
Garden vegetables, ...	22–66	140–440	11 –352

(*h*) Chili saltpetre yielded an increase of ten per cent over ammonium sulphate when applied to barley, wheat, rye and oats.

(*i*) The cause of this superiority of the Chili saltpetre over the ammonium sulphate lies in the fact that during the nitrifying process of the sulphate of ammonia ten per cent of its nitrogen escapes. Whether this nitrogen escapes into the air, or whether it is consumed by the nitrifying organism, as Frank believes, is unknown.

(*j*) Warm, porous soils, rich in lime, favor the most rapid nitrification of ammonia compounds. When the soil is lacking in lime, sulphate of ammonia works poorly as a fertilizer. Its action can be greatly improved by liming the soil. The lime neutralizes the sulphuric acid set free in the process of nitrification, and thus prevents an acid soil. It is well known that bacteria, as a rule, will not work when free acid is present.

(*k*) Soda, as it is found, for example, in nitrate of soda or in common salt, contrary to previous teaching, can in certain plants take the place of potash to a considerable extent, and exerts a correspondingly beneficial influence. This has been proved in the case of barley and poppies; further investigations on this subject are in progress.

(*l*) Wagner's experiments have shown that nitrogen in different manures has the following relative worth: —

Nitrogen in Chili saltpetre, ...	100
Nitrogen in sulphate ammonia, ...	90
Nitrogen in blood, and in green plants as manure, . .	70
Nitrogen in fine bone, ground fish and tankage, ...	60
Nitrogen in stable manure, ...	45
Nitrogen in fine-ground wool, ...	30
Nitrogen in fine-ground leather, ...	20

Extensive investigations are being carried on to determine the relative needs of the different crops for phosphoric acid and potash, but as yet a detailed report of the results has not been published. Small bulletins have, however, been given out, from which one obtains the following facts:* —

Phosphoric Acid.

(*a*) Placing phosphoric acid as found in dissolved bone-black at 100, the phosphoric acid from Thomas slag and fine-ground bone has the following relative worth: —

	First Year.	Second Year.	Third Year.
Phosphoric acid from bone-black, . .	100	–	–
Phosphoric acid from Thomas slag, . .	59	–	–
Phosphoric acid from fine-ground bone, .	5	15	17

(*b*) Thomas slag has been found to have rather more than half the fertilizing value of soluble phosphate the first year. This material becomes gradually soluble in the soil, but, on the contrary, does not "revert" or become insoluble, as is the case with superphosphate. It can therefore be applied in large excess, and it is especially valuable on marsh lands rich in humus, and for fodder crops, grasses and all crops that need a *gradual* supply of phosphoric acid, and which have a long growing period. Thomas slag can be applied in such quantities that there will be sufficient available in the soil each year to furnish the crop with the needed supply. By this I mean that the *large quantity* of slag applied to the soil would equal the soil's phosphoric acid capital, and that the amount available each year (being sufficient for the crop) would equal the yearly interest on the capital.

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* A very excellent translation of Professor Wagner's lecture on "The most profitable use of commercial manures" has been made by Prof. Charles Wellington, and published as a special bulletin of the Hatch Experiment Station, May, 1890.

(*c*) Soluble phosphoric acid should be used rather on light, sandy soils, and on quick-growing crops, such as early vegetables and grains.

(*d*) Raw, undissolved phosphates have no particular manurial value.

Potash.

(*a*) All the grains have great need of potash, much more so than is commonly supposed. Especially is this true of barley; then follow in order wheat, rye and oats.

(*b*) Next to the grains, meadows and grass lands generally have great need of potash, and from 550 to 600 pounds of kainite can be applied with excellent results. An application of phosphoric acid and potash to meadows causes the clovers to come in, thus increasing the value of the hay and the nitrogen content of the soil.

(*c*) Next to the grasses, the legumes, such as peas, beans, vetches, lucerne, clover and serradella, are thankful for potash, and must be well supplied with it in order to enable them to assimilate the free nitrogen of the air.

(*d*) For potatoes and sugar beets potash works better upon a loamy rather than upon a light sandy soil.

(*e*) The soils most in need of potash are the marshy, peaty and light sandy soils.

(*f*) Potash should be applied in the autumn, if possible, and ploughed in. A simple top dressing for meadows is sufficient.

(*g*) Soils lacking in lime should be dressed with this material, in order to get the greatest good from the potash.

As my final word, I wish to present some general deductions, drawn by Professor Wagner from the results of his many experiments.

1. By a liberal manuring with potash and superphosphate, we must make the nitrogen-gathering plants *nitrogen-hungry*, in order that they will take from that nitrogen magazine, the air, the largest possible quantity.

2. For the nourishment of the nitrogen-consuming plants — the grains and hoed crops — we must take the greatest amount of nitrogen from the air, as the very cheapest source. This end can be best attained by a rich manuring of meadows, by devoting an increased area to leguminous crops, and especially by planting leguminous crops to be ploughed in as green manure, and by manuring them liberally with potash and superphosphate.

3. In so far as the nitrogen taken from the air or obtained from stable manure and green manuring is not sufficient for the growing crops, we must make up for it by applying as much sulphate of ammonia or nitrate of soda as the crops can use to advantage, considering the condition of soil and climate.

4. The manure obtained from animals fed with leguminous crops is naturally rich in nitrogen, and the loss of this nitrogen can be prevented by frequently scattering superphosphate or sulphate of potash and magnesia into the stall and over the manure.

5. We must try to make the crops appropriate all the nitrogen given to the soil in the form of stable manure, green manure, Chili saltpetre or sulphate of ammonia. To attain this end we should manure liberally with potash and phosphoric acid.

6. When the soil is found lacking in lime, we must spread marl or quicklime over it, so that the plant may not be prevented from taking up the nitrogen, potash and phosphoric acid.

The above rules must not in every case be taken as an infallible guide, but rather looked at in the light of a general statement, and as such are productive of satisfactory results.

THE RELATION OF PUBLIC SCHOOLS TO AGRICULTURE.

BY JOHN E. KIMBALL, OXFORD.

Agriculture is a constant factor in the world's economy. The theatre of its exercise may shift, its conditions may change, its interest may fluctuate, but it can never become obsolete.

> "Age cannot wither her, nor custom stale
> Her infinite variety,"

for, as man sprang from earth and returns to earth, so from the earth his nourishment must largely be derived. The race, then, has a permanent interest in the culture of the soil, and each succeeding generation inherits this interest, with its benefits and responsibilities.

Public schools are schools of the people, and collectively stand for popular education on primary, secondary or higher levels. In the constant readjustments made necessary by our advancing civilization, the manifest trend is towards extension in time, expansion in scope and wiser adaptation; or, as some one has expressed it, "bringing schools into parallelism with life."

By these postulates the query embodied in the subject assumes this form, "How is popular education, beginning in the kindergarten and expanding into all the possibilities of university extension, related to those industries which are immediately dependent upon the product of the soil?"

To insist upon what has been so pithily expressed in that truism, "The best product of the farm is found in its boys and girls," would be to beg the question; but it is a fact which must not for a moment be lost sight of in considering the bearings of the educational problem.

There is also an important relationship between the school and the farm which must not be too strenuously insisted upon, because it subsists in connection with all other industries as well; but it is no less valid on that account, and is entitled to a place in the argument. I refer to those elements of success which in a greater or less degree are the inevitable result or more exactly the presuppositions of a public-school education: punctuality; industry and application; earnestness and fidelity; patience and perseverance; method, neatness and economy; self-denial and self-control; loyalty, honesty, self-sacrifice and courtesy; and, were these cardinal virtues even more diligently and more successfully inculcated, the interests of agriculture would be in like manner promoted.

It is high vantage ground if we can assume that elevation of faith, or philosophic insight, or what you will, which to the spirit of investigation presents the social organism, with all its activities and interrelations, as one complex but harmonious whole, in which the supply of every rational want must work a reflex benefit in the interest of all.

Whatever tends to familiarize the child, even in its earliest experience outside the nursery, with objects, facts and forces appertaining to rural life, is furnishing that child with capital which may one day be available for practical uses. These same agencies are, by common consent, among those best calculated to promote a healthful growth in the process of normal development.

Leaves and blossoms; trees, plants and shrubs; clay, sand, loam; birds, insects, domestic animals, with their productions, changes, growth and development, furnish an exhaustless variety of object lessons which the alert, perceptive faculties of children delight in, and which, under wise direction, will yield no mean equipment of useful information. Nor is the work here limited to the culture of the intellect by dealing with barren facts. There is scope for the higher culture of emotion and sentiment. No child is well trained whose feelings of kindness and compassion towards the lower orders of animate creation are not so cultivated as to make neglect unnatural and cruelty impossible. The moral aspects of such culture must and can safely be left to that evangel of humanity, — may its name be exalted! — so faithfully and perseveringly proclaimed from its headquarters on Milk Street; its business phase alone falls within the limits of this paper.

Sympathy, magnanimity, generosity have room for their exercise even in dealing with dumb creatures, and the brutes appreciate it. While the semblance of these qualities, begotten of the greed of gain, would doubtless be spurious, and so of questionable merit, their genuine counterparts have not only a moral but a money value. If the causes of failure among unsuccessful farmers could be fully set forth, there is no doubt but the absence or decadence of the humane virtues would occupy a prominent place. I have seen in a farmers' institute, not many years ago, an effort to inculcate more of this spirit of kindliness towards domestic creatures met with a bantering levity little short of ridicule. If this be possible among progressive agriculturists, what can be expected from the less intelligent and thoughtless?

The curriculum of the primary school, even, if wisely planned, will provide for those acquisitions and virtues which lie at the very foundation of successful husbandry; and it is the more important as being the seed-time of principles and predilections which, in determining quality, rank all subsequent cultivation.

Such work, well begun in childhood, broadens and deepens in advancing years. Every lesson may be emphasized by a new presentation and enforced by generalizations only revealed to the outlook from a higher stand-point. Trees and shrubs which have been examined and admired as individual objects may be analyzed and grouped according to species and genus, their parts studied, their wood compared as to texture, properties and uses, their fruits considered in relation to health, luxury and profit. And so of all crops and all products, most of the objects and many of the industries in this realm, an acquaintance with which, in detail, would be rich in resources for recreation and instruction.

There is a point of contact for the public school and the guild of husbandmen in the agricultural fair, — a contact prolific of advantage to both. This advantage, either by accident or design, has to some extent been recognized.

One of the most interesting features in the Worcester-East fair of the last autumn was the display of class work from the school children, — not so much for its extent, variety or excellence, as for the possibilities which it suggested. That this Board is not insensible to this advantage is evident from its recent action: "*Voted*, That the societies receiving a bounty from the State be requested to offer annually to the school children a sum of not less than twenty dollars in prizes for herbariums of flowers, grasses and ferns, and for collections of the different varieties of wood grown in New England," — an advance step in the right direction worthy of all praise. Between the simplest specimens of handiwork in the kindergarten and the best achievements of the senior class in the high school there is a range of latent force which agriculture might enlist as one of its most potent allies.

In the increasing demand for training which bears more directly upon the arts of life, drawing has become a recognized essential, and here nature's types furnish at once model, ideal and inspiration. Leaf and plant forms, in whose study and imitation the sense of beauty and symmetry is awakened and tiny fingers are first trained, may later supply specimens for the more skilful hand, which, under the exhaustive analysis of the compound microscope, is to enrich science by its contributions. Nor does the work stop here; these same forms, combined, grouped and conventionalized, minister to our æsthetic sense in the art features of architecture, household furnishing and decoration.

If in the public school of the future some form of manual training shall become an essential, as it is now an incidental, feature, its relation to the work of repair and construction incident to farm life will be too obvious to require comment.

But such exercises, fitted to develop artistic and mechanical skill, are not only related to and valuable in agricultural life, but they open the way to useful and remunerative employment in other lines, and, as such, are entitled to represent the work of students as a class. Let the earnest work of our boys and girls be fairly represented in competing industries and there will be less demand for those cheap devices for entertainment which are a menace to the character if not the very existence of the agricultural fair.

To develop with any degree of fulness all the actual and possible relations of education to agriculture, especially in those more advanced lines where study takes immediate hold of the practical industries, were to write a treatise, rather than a brief essay whose modest aim is merely to suggest.

If the soil of the earth is an exhaustless storehouse of material wealth; if plant growth is the endless process whereby the prime necessities of our physical being — food, clothing and shelter — are supplied; if its products are the great source of those mighty activities which make society what it is, and effect the commercial solidarity of the race, — no institution or movement whose mission is to teach the art of living can safely neglect to solve their mysteries and inculcate their laws.

This embraces a wider range than at first appears. The culture of fruit and cereals and roots; of trees, vines and flowering plants; the rearing of food-producing animals, — are but the rudiments. The staple fibres of textile industries, timber and cabinet woods, gums, resins, perfumes and drugs; the constituents of soils and the chemistry of plant foods; the influence of climate and its variation; the relation of producer and consumer, of supply and demand, of competition and market, — all claim the best fruit of the most profound research. Here the higher institutions find ample scope for the most advanced thought, and special schools an arena for their highest ambition.

The university extension movement, which, like a great tidal wave, is passing over the educational world, is full of significance. Starting in England forty years ago, under the auspices of a university philanthropist, as a concession to social discontent, and hence a *quasi* necessity, and carried on against prejudice and distrust by educating the people to its appreciation, it touched our shores but recently, to be welcomed with open-armed hospitality. This welcome signifies that, despite its name, which might retain a flavor of social distinction and therefore of exclusiveness, it is in fact an extension of our popular education, so germane to our republican institutions and so dear to the heart of the average American citizen.

University education may be defined according to adaptation as that suited to adults, and in kind as not only higher but broader than that required during the period of youthful development.

University extension, as defined by one of its leading apostles, is "university education for the whole nation, organized on a basis of itinerant teachers." It is an effort to bring to the very doors of the masses those advantages for knowledge and culture which have been regarded as the exclusive privilege of the favored few. In the language of an official description, "The purpose of the university extension movement is to provide the means of higher education for persons of all classes and of both sexes engaged in the regular occupations of life. It is, in fact, an attempt to solve the problem of how much of what the universities do for their own students can be done for persons unable to go to a university."

It is fitted to meet the wants of a free people, dependent upon personal exertions for a livelihood, for it is purely voluntary, unlimited as to requirements of age and range of subjects; hence it is that supplementary feature which brings the educational process into "parallelism with life."

Its relation to the interests of agriculture becomes manifest in its very definition. It proclaims to farmers everywhere that their craft does not necessarily divorce them from the pleasures and advantages of intellectual culture, with all which that culture implies, but brings to the veriest churl the achievements of the highest intelligence in his own special field, and invites him to a free participation in its benefits. It says to every man, woman and child, regardless of age, color or social condition, whether drudging in poverty or surfeited with the luxuries of wealth, — "Come up higher."

This movement is still in its infancy, but it is an infancy of exceptional promise, and therefore claims the fostering patronage of those who are prominent in the interests of agriculture; for the idea upon which its plan is formulated renders it specially adapted to benefit those who are devoted to that industry. By a wise and liberal encouragement of this latter-day intellectual reformation, the temples of learning may be practically thrown open to tillers of the soil, and agriculture, quickened by the impulse of a new life, made to respond to the magic touch of more intelligent labor.

An old Roman apologue runs as follows: "A vine-dresser had two daughters and a vineyard; when his older daughter was married he gave her a third of his vineyard for a portion, notwithstanding which he had the same quantity of fruit as formerly. When his younger daughter was married he gave her half of what remained; still the produce of his vineyard was undiminished, — the result of a threefold concentration of his labor."

Success in farming is not so much a question of hours, muscle and acres, as of power concentrated by intelligence. Brains are the best fertilizer.

From the foregoing we may safely assume that there *is* a relation between popular education and agriculture, and perhaps form some idea of the character of that relation.

What bearing has it upon the functions of this Board?

It may not be possible, and, if possible, might not be desirable, for the department of agriculture to invade the province of education; but there may proceed from it an influence calculated to enlist the interest of those for whom such education is provided, and by whose wants its appliances are determined.

The tendency of new ideas in education is to work downward rather than upward, and State departments are in a condition to influence institutions over which they exercise supervisory control. If experiment stations, agricultural, technical and industrial schools, create a demand for specific qualifications, elementary departments will quickly recognize that demand, and yield a ready response.

Again, the State Board of Agriculture may, as it has done, recommend and eventually prescribe, to a limited extent, the disposition of State bounty, and so encourage those features which make for prosperity and repress such as are indifferent or prejudicial.

Finally, this Board may largely determine the character of the agricultural fair. The public school in the rural district is often composed, to a great extent, of farmers' children. Let their work not only be recognized, but encouraged by the offer of substantial premiums. Let those premiums not be confined to excellence in scholarly lines, but embrace noteworthy success in farm work, gardening and floriculture; but in all cases stand for exhibitions by *school children*. There has been, hitherto, too much interest in the farmer's pigs, and too little interest in the farmer's children; too much in his cultured acres, and too little in his uncultured home. If we would elevate the standard of agriculture, it must be by means of personal intelligence, cultivation and refinement, brought to bear upon the several departments of farming life. Something may be done for those now on the stage, but our hope lies in the oncoming generations of the future. Let the annual fair be an educational institution, with a serious purpose, and not a field-day for impostors and mountebanks, nor yet a carnival for blacklegs in disguise; for, if there is one class which may be said to be pre-eminently prejudicial to the legitimate interests of agriculture, that class is the sporting fraternity, and, under whatsoever guise it seeks to commend itself to recognition, it should be most jealously circumscribed.

In the effort to furnish rational instruction and entertainment at these festivals, the farming community should be induced to turn not only their barns but their cottages inside out, and so exhibit, alongside the marvellous results of industry and skill which make the farm profitable, the evidences of those higher endowments which render irresistible to its members the attractions of the farmer's home. And here belong those emanations of taste, ingenuity and skill, the fruits of amateur studies or industrious leisure, which mean that life is not all drudgery, nor life in a farm-house a mere struggle for existence.

If this phase of home industry could be so encouraged as to beget a generous rivalry, if that rivalry could result in making the homes more attractive, and that attraction hold the young even a little longer to their childhood's allegiance, who can measure the benefits to American citizenship? "By such means," in the language of a contemporary, "is to come the civic salvation of the American people."

I like to think of that old heathen fable of Hercules and Antæus as typifying a great physical and moral conservator for the rising generation. Antæus, son of Terra, the mighty wrestler, was invincible so long as he remained in contact with his mother Earth, and in a contest with Hercules rose with renewed vigor from every fall, but when lifted away from the source of his strength was easily strangled in the air.

Our young people are in conflict with Herculean forces, pitted against them in mortal combat. Severed from the salutary influence of country homes, and subjected to the artificial conditions of urban life, they too often fall an easy prey; but kept in touch with mother Earth, soothed by her magnetic contact and nerved by her health-giving power, the gigantic forces of evil which would compass their ruin are stayed, if not broken.

GOING WEST.*

BY LYSANDER S. RICHARDS OF MARSHFIELD.

Seventeen years ago I visited California, reaching there about the middle of May and remaining until November. Two years ago I went to southern California and from thence northward to the wheat and grain region, where I remained until spring. In May the contrast between the snow caps of the Sierras and the rich green grass fields of the Californian valleys is most marked. But before the end of June not a blade of grass is to be found, and the desert-like monotony is only broken by grain fields, vineyards and gardens. During the dry season a cloud is of rare occurrence. Not a shower fell during the first five months of my stay in California. The amount of dust can be easily imagined, and the discomfort of travelling at this season as readily understood.

The spring season begins in January or February. The grass remains fresh until June, and hence the season when there is good pasturage for cattle is from January to June. During the remainder of the summer, stock can obtain but a small amount of feed from the dry grass, and must be fed in addition to their pasturage, unless they are driven to the mountains, where summer rains keep the grass fresh and green. Owners of large herds on the foot-hills are accustomed to drive them to the mountains for the dry season and back to the foot-hills for the balance of the year. In this way the stock are kept at pasture for the whole twelve months. There are no fences, and the cattle roam the country over. Even cows kept for family use are turned loose, and must be hunted up each evening, sometimes necessitating long journeys and consuming considerable time. The cows are confined for the night in a corral or yard. The winters on the foot-hills are very mild, and freezing weather is rarely experienced. It rains much of the time, but more often during the night than in the day time, and but seldom snows. Our common New England grasses are but seldom seen. Oats, barley and alfalfa are grown, but are cut green and made into hay, and this constitutes the agriculture of the foot-hills. When this hay is plenty it sells for ten or fifteen dollars per ton, but when scarce sometimes advances to forty dollars. Shorts and middlings are largely fed to cows in the dry season, and the feed of a cow costs forty cents per day for four or five months. Milk sells for twelve and one-half cents per quart.

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* On account of the increased size of the volume "Agriculture of Massachusetts," we are able to print only an abstract of this paper.

The usual course is to raise a crop of oats or barley, which is sown in the fall, plough the field the following year and leave it without a crop. This is called summer fallowing. The third year a crop is again taken. If a crop is required every year, dressing is freely used in the mountain towns. The dressing costs nothing. Most of the gardens of these districts are cultivated by Italians, who raise fruit and vegetables for sale. These gardens are liberally dressed with manure, sometimes as much as forty cords per acre being applied. The ground is kept under a crop the entire year, one crop immediately following another.

All kinds of vegetables that are grown in the East are raised. Tomato vines are trained on poles. I have seen them growing eight feet high. The fruit is thus exposed to the sun, and ripens fast. These gardens must be irrigated during the dry season. Strawberries ripen the latter part of May; early apples, peaches and apricots in July; pears, plums, nectarines and sweet-water grapes in August. Potatoes are full grown in June. Orange and pomegranate trees grow and produce well. Almond and olive trees grow well in that locality, and bear plentifully. The almond and olive trees resemble peach trees. The black walnut tree is grown in yards for shade and ornament, and produces nuts somewhat resembling the English walnut. Fig trees produce three crops in a year. The fruit is very sweet, soft and pulpy, and will keep but a few days after it is fully ripe.

The dried figs of commerce are as little like fresh ripe figs as dried apples are like fresh ripe pippins.

This seems the natural home of our cultivated flowers; even among the foot-hills they grow with the greatest luxuriance. Roses and oleanders grow to be as large as ordinary pear trees, and bloom throughout the year, the mild winter having no damaging effect upon them.

I spent several weeks on a grain ranch near Stockton. It contained two thousand acres of fine level land, with not a native tree upon it. Ten miles of four-slat board fence, costing five thousand dollars, had been built to enclose it. The land was very sandy, and did not appear to be capable of sustaining plants of any kind, but it will produce from eight to twelve bushels of wheat per acre without the application of fertilizers of any kind. These sand plains are used only for the production of grain, and the ranchers have usually done fairly well. One who farmed five thousand acres could not make it pay for several years, but at last one favorable season gave him an extra large crop, and he was enabled to pocket fifty thousand dollars from it. These wheat farms are all large, none being less than a quarter section, or one hundred and sixty acres. With proper machines one man can care for six hundred and forty acres. Gang ploughs are used, and the seed is dropped from a seed-box attached to the plough and covered at the time of ploughing. Vegetables and fruits grow well in this section.

There is another class of land used for wheat growing, viz., the black clay or "doby" land. This is much more productive, but is also much harder to work, and in an unusually wet season cannot be worked. It must be summer-fallowed once in three years. One hundred acres is all a man can care for, and highways in this section become impassable in the rainy season.

Grain growers commence to sow and plough as soon as the rainy season begins. Often on large farms they sow a portion during the dry season without ploughing, simply harrowing it in. The wheat needs no rain after April, and the growers do not want to see a drop of rain from April to the last of November. Rain in May starts the weeds, in mid-season it lodges the wheat, and late in the season it damages the straw lying on the ground. Cutting usually commences early in July, but the last of the straw is not stored, or rather stacked, until October. Wheat is California's greatest product, and the long dry season is a necessity to the wheat farmers. The wet season is equally necessary to ensure a crop for the next year.

Twenty or thirty horses are required to carry on a large farm. Mules are now taking the place of horses, as they are tougher and stronger. They are raised on the ranches, and a good jack for breeding is worth from eight hundred to one thousand dollars. Horses are fed from the stack or mow. Those not at work are pastured with the cattle, running at large all winter in the grain fields, and each drove usually has a leader. Snow rarely falls. Every ranch is supplied with a windmill for pumping water.

Harvesting is done with a large harvester, costing about a thousand dollars. It cuts a swath twenty feet wide, cuts the wheat from the stalk, lands it on a header, separates the wheat from the straw, threshes it, winnows it, pours the wheat into a bag, sews the bag up and drops it on the ground ready for market. The harvester is generally worked by horses. To bag from one thousand to fifteen hundred bushels of wheat is a fair day's work.

In southern California many of the large farms have been cut up into small holdings. Most of the farms are devoted to fruit raising, and a ten-acre farm is not uncommon. Irrigation is necessary in this section, and this makes it impossible for a man of limited means to carry on a large farm. Again, eight or ten years must elapse before an orange grove will bear paying crops, and a heavy expense must then be incurred in fumigating the trees to rid them of the scale insect. In irrigating, a space twelve or fifteen feet square around each tree is inclosed in ridges of earth. The irrigating ditch company sells the water to the fruit and vegetable growers in such quantities as they desire. The main ditch flows beside the road, and the water is let onto the different farms as it flows along. The farmers have to take their turns, and must be on hand when the water arrives, or they will lose it. It may come weekly or monthly, according to the supply and demand.

In southern California oranges, grapes, apricots, English walnuts and olives are chiefly grown. Bananas are grown only in sheltered places, and even there must be covered at night to protect them from frost. The navel oranges are the most attractive, and much larger than our largest apples. Grapes for raisins and for other purposes are the main crop in some sections, though many vineyards have been destroyed by some unknown disease. The vineyards of California are very large, often containing a hundred acres. The vines are staked up for five or six years and trimmed to a stump, which by that time becomes strong enough to support the vine. They are trimmed back to the bare stump each year, the new canes making a large bush, bearing sometimes two bushels of grapes.

Much money has been lost in the purchase of land in southern California. A few years ago there was a great boom in the region of Los Angeles, and prices ran as high as three hundred dollars per acre. People arriving in the evening sometimes viewed the lots and made purchases by the light of lanterns. Banks and hotels were erected in many cases to help sell the land, but were never occupied. Now the boom has burst, prices are once more at the normal level, and it is difficult to sell. The boom was more particularly confined to the southern portion of California, but has injured the sale of land all through the State.

The Pueblo Indians, residing in the northern portion of New Mexico, practise agriculture and horticulture, and are somewhat civilized. Their houses are large and substantial, and have been in existence for three hundred years. They are grouped closely together around a large Jesuit church. The Indians are neatly and rather attractively dressed in the Indian attire. The population neither increases nor decreases, but remains stationary. They are thrifty and good farmers, and their gardens are well irrigated.

The greater portion of Arizona and New Mexico is a vast sand plain, which is entirely unproductive. Possibly this country can be made productive by irrigation, if the water can be obtained by boring artesian wells. At present mining is the principal industry, especially in Arizona. There are many cattle grazing in these territories, but the feed is poor and the cattle correspondingly so. In Nevada and Idaho there is better feed for cattle, though the severe winters sometimes cause very great losses to the cattle owners. Whole herds have sometimes perished from cold and starvation.

In Colorado farmers are, I think, more successful. If I were bound to go West, Colorado would be my choice. It possesses a climate as fine as that of southern California, the chances of success are as good as anywhere in the West, and it is a growing country. In seventeen years the population of Denver has increased from twenty thousand to one hundred and twenty thousand. A farmer in south-eastern Colorado told me that his sales from one hundred and sixty acres amounted in a year to twenty-five hundred dollars. His principal crops are alfalfa, potatoes and melons, and they are raised by irrigation. Corn is left on the stalk all winter, and picked as needed for feeding. At Iron Springs pioneers are taking up government lands at a dollar and a quarter per acre, and selling to a syndicate at five dollars per acre. The syndicate is bringing water from the Arkansas River by irrigating ditches, and may be expected to make the naturally rich soil very productive.

A grain farmer or a stock raiser must necessarily have a large farm, and for such the West is of course the place. On the other hand, there is in Marshfield, Mass., a small farm of but a dozen acres, the sales from which last year equalled those from a seven-hundred-acre grain and stock ranch in which twenty thousand dollars is invested. The small farm gets tenfold the attention per acre that the large one does, and that is what pays. If many of our large farmers would expend their labor on twenty-five acres of their best land, and let the rest grow up to wood, they would reap a much larger profit than they do to-day. To young men, young farmers, and particularly to young married men, I say Don't go West! I have never found a good place waiting for some one to step into it. For every good place there are plenty of applicants, and if the place demands more than ordinary intelligence there are plenty of men on hand to fill it. No matter how far West you go, there are intelligent men there before you; and, though we regard our Boston as the Athens of America, we must not forget that we do not possess all the brains of the country. The great West has its share of mental activity, as its wonderfully rapid development testifies.

It is useless for a farmer to go West unless he has considerable capital. Everything, save fruit culture, is done on so large a scale that much capital is required at the start. And even for fruit culture you must have capital enough to support you for several years until your trees and vines reach the bearing age. Even if you have this capital, you had better stay here with your friends and enjoy it. If you cannot make farming pay here, you may be sure you cannot there. If you want to be a pioneer and a martyr to the development of agriculture and civilization, go West by all means. You are just the man they want there. If you want to buy government lands at a dollar and a quarter an acre, five, ten or twenty miles from any habitation, and live on them a few months, just long enough to meet the requirements of the law, why go. But as soon as your time is up you will be glad to return to your old New England home.

I rarely met a lady from New England in the agricultural districts of the far West who was not yearning to return East. If married, you had better stay at home, for your wife's sake as well as your own. There are plenty of farms in New England waiting for young men who are up with the times in improved methods of agriculture, men with brains and energy enough to take advantage of the opportunities of the situation. To the man fitted for the business of farming, and possessed of a genuine love for it, there is money in it here, and as much if not more than on the farms in the far West.

THE BENEFITS RESULTING FROM AGRICULTURAL SOCIETIES.*

BY Q. L. REED OF SOUTH WEYMOUTH.

The early organization of these societies consisted of a body of citizens incorporated under the laws of the State, for the purpose of promoting useful improvements in agriculture by holding annual exhibitions, at some central location arranged for the purpose, bringing together for these exhibitions their live stock and the products of the soil, with perhaps a ploughing match added. Exhibitions were usually held in the open, with but very little expense attending them, creating a fund for the society from the fees for membership and charges of admission to the hall and grounds to those not members, and awarding premiums upon the best exhibitions of live stock and the products of the soil. At a later period grounds were purchased by many of the societies, tracks were laid out, and trotting races and various kinds of amusements were added.

As the keeping of live stock is of so much earlier date than the agricultural society, it is interesting to know the origin, and where and when the improvements began which have culminated in the high degree of perfection shown at our annual fairs. At an early period we find special mention made of the vast herds of Job, but we hardly suppose agricultural societies were then organized, although there would appear to be no reason why Job, and many other of the old patriarchs of that time, might not have been considered whole agricultural societies in themselves. Among the vast herds of Job we find the ox, ass, sheep and camel, only, spoken of. The horse was not used for domestic purposes. Horses and wagons are mentioned during the period of the famine, when Jacob and the patriarchs removed into Egypt. At a still later period we find presents of horses being sent into Arabia among the Oriental rulers. In the early part of the eighteenth century, according to historical accounts, the modern race and dray horses were unknown in England, while along towards the latter part of this same century we find England exporting to this country such horses as Diomed, Eclipse, Fearnaught, Messenger, and, at a little later period, Trustee, Leviathan and the beautiful Glencoe. This would seem an impossibility were it not for the fact that in the early part of the same century three horses were imported into England, the blood of whom is said to run in the veins of every thoroughbred horse in that country, in the male line. The first of these was Byerly's Turk, the second Darley's Arabian and the third Godolphin Arabian. There can be little doubt of the nativity of the horse being in Africa, and that it is to the Barbs that we are indebted for the foundation of the English thoroughbred horse.

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* On account of the increased size of the volume "Agriculture of Massachusetts," we are able to print only an abstract of this paper.

In 1747 Rev. Dr. Jared Eliot of Killingworth, Conn., published a series of six essays, under the title of "Essays on Field Husbandry, wrote from a Journal of Thirty Years' Experience." In the beginning of his second essay he says: "The last year's essay having met with a more favorable reception than I expected, fifty of the last year's essay having been sent for by B. Franklin, Esq., of Philadelphia, a person of merit and learning; being encouraged by him, as also by other gentlemen in these parts, of worth, capacity and learning, on whose judgment I depend more than my own; therefore, agriculture being a profession so useful to mankind, that notwithstanding it hath from the vast variety of depending objects very numerous uncertainties attending it, I shall proceed to make the best of such a difficult subject, in which times and seasons make such great alterations." Knowing his connection with other prominent organizations in Philadelphia, and his interest in these essays, although I have no data to that effect, the inference would be that Benjamin Franklin was one of the prime movers in the organization of the first agricultural society in this country.

One point is noticeable in these essays, showing the results of a change of condition. Instead of building dykes to keep the salt water out, an owner of land dug ditches to let the salt water in, for the purpose of enhancing the value of his land.

In 1760 Mr. Bakewell began improvements in the breeding of cattle, commencing with the long-horns, and to him we are also indebted for the perfection of a new race of sheep, at that time called the Leicester. He also made great improvements in certain products of the soil, and with such success that some farmers from a distance made application in disguise to him for employment, for the purpose of learning the secret of his success. They were accepted, and continued with him only until they had acquired his methods. Although improvements in this country were checked during the revolutionary war, at its termination the improvements in certain departments of agriculture, especially in live stock, were very rapid, and have culminated in the high degree of perfection which we have at the present time.

The earliest agricultural society we find mentioned in England was organized in 1777, and was called the Bath or West of England Society. This society seems to have been organized during a period of war, but, as the war was so far away, the agricultural interest at home would naturally be somewhat improved. The first agricultural society in this country was at Philadelphia, in 1785, eight years later than the first society in England. The next was the Highland Society, in Scotland, instituted in 1785, and the National Board of Agriculture was formed in 1793. The next in this country were the Massachusetts Society for Promoting Agriculture, at Boston in 1792, and one at New York in the same year. These were the societies organized previous to the nineteenth century, and, although England had been settled for something over seventeen centuries, and this country only about a century and a half, they are found to be nearly contemporaneous with each other in the organization of the early societies. History shows that civilization is the cause of the formation and development of the agricultural society, and that improvements in agriculture can be best brought about by the association of persons interested or engaged in that occupation.

The country at the close of the revolutionary war was in a somewhat crippled condition, but soon recovered, and from 1800 to 1820 the business of the country was in a prosperous condition. New agricultural societies were established during this period. Among them were the Berkshire Society, in 1811; the Hampshire, in 1814; the Essex, in 1818; the Hampshire, Franklin and Hampden, in 1818; the Plymouth, in 1819; and the Bristol, in 1823. It was in 1818, through an act of the Legislature, that the bounty from the State was first granted to agricultural societies, which still continues. From 1819 to 1844, a quarter of a century, with the exception of the Bristol in 1823 and the Massachusetts Horticultural in 1829, no new agricultural societies were organized. From 1844 to the present time these societies have gradually increased in number. Three new societies were organized between 1844 and 1850, eleven between 1850 and 1860, six between 1860 and 1870, one between 1870 and 1880, and seven between 1880 and 1890, according to the acts of incorporation.

We now arrive at the period of the agricultural societies of the present day. Some progressive methods have been advanced in regard to conducting these societies and the agricultural interests of the State. It has been said that "the success of an agricultural society does not depend upon holding a fair." That may be true; but would the agricultural interest throughout the State derive the benefit that it does under the present system, where the individuals of the town or county bring together their live stock and the products of the soil, meet and compare them and suggest improvements? The fair is an educator. It educates through this method the whole community, and creates an interest which, if fairs were omitted, might be lost to a great extent. Another statement is that "it is not necessary that these societies should have grounds to hold these fairs." This also may be true, for every society has features peculiarly its own. If the old Essex chooses to hold its annual fairs in the open, in the old primitive style, after the real original, solid foundation of all these societies, that is all right; but should we attempt to carry out that idea at this late day among some other societies one year would about terminate their existence. In many instances these grounds are almost invaluable as public parks or for public gatherings, as well as for agricultural purposes, especially in a mixed community, both agricultural and mechanical. In some cases gifts of grounds are made to the towns for public parks, where nothing of this kind exists.

It would perhaps be unwise to discontinue trotting races wholly, when we take into account the great interest there is in the horse throughout the country. Every society knows about what its average annual receipts are, and should govern itself accordingly in its offer of premiums. The day is past when the offer of very large premiums can be relied on to increase the receipts.

The officers of the Massachusetts Society in 1811, in speaking of the benefits resulting from its organization, say that "Great improvements have been made in butter and cheese. The breeding of cattle and of sheep has been more attended to than formerly. The trustees feel the highest satisfaction in having offered the first premium, five hundred dollars, for encouraging the importation of Merino sheep." In the offers of premiums of this society at this time were one hundred dollars for the cheapest method of destroying the canker worm; thirty dollars for the largest quantity of wool, meat and tallow from the smallest number of sheep, not less than ten in number; one hundred dollars for the cheapest method of raising water from rivers and ponds, ten or twenty feet, for the purpose of irrigation; fifty dollars for the greatest variety of grasses; and "to the person who shall ascertain by accurate analysis the constituent parts of several fertile soils, respectively, and in like manner the parts of several poor soils, and shall discover the defects of the latter, and shall show by actual experiments how the said defects may be remedied, by the addition of earths or other ingredients which abound in the country, and in a manner that may be practised by common farmers, fifty dollars." This, it will be seen, was previous to the establishment of agricultural colleges, and before agricultural chemistry had been much introduced into our educational institutions.

The subject of the benefits of these societies is one that could be theorized upon to almost an indefinite extent, but perhaps some practical illustrations may be quite as interesting. I know of no more marked illustration than is shown in the abundance of fruit, especially pears, which was seen in the fall of 1891. A great portion of the orchards, in whatever locality, will be found to date back to the time when such magnificent displays were made at the Massachusetts Horticultural Society and the old Norfolk Society, by the late Marshall P. Wilder. Other practical illustrations could be made quite as prominent as this; but I have a short article taken from a publication, which conveys my own views, and which, from an experience of thirty years and more, I could illustrate practically. * "Those who look only on the surface, or who have never got in the stream of progress, often assert that we have too many agricultural societies, or that they do but little good. The fact is, our agricultural societies are making such continued progress, and do their work so silently, that the most active members do not realize how much they have done. How many stop to ask the question, What would be the condition of agriculture to-day if there had been no agricultural societies? Alas, how few even think of it! When agricultural societies were formed, and exhibitions held where the products of the farm were placed side by side for comparison, it stirred up a desire to secure the best breeds of animals and the best varieties of fruits and vegetables; every portion of the globe was carefully examined to find the best specimens of animals and vegetables. When these were collected together, and exhibited by the side of what we had been producing, the people saw the difference, and rapidly introduced the improved productions on their own farms; so that to-day improved fruits and vegetables are so wide-spread that the poorest man can every day place on his table better fruits and vegetables, and in greater variety, than could the richest monarchs of Europe a hundred years ago. By comparing the products of our farms at the annual shows, a desire has been created for higher cultiva-

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* Edmund Hersey in "The Old Farmer's Almanac," 1893, p. 44.

tion; and thus gradually the farmers have abandoned the methods of their fathers for methods which searching investigation has proved to be easier and productive of better results. The boards of agriculture, farmers' institutes and the grange all owe their existence to agricultural societies; and the social condition of the people has been harmonized and lifted to a higher level, because the societies have established a platform so broad that all classes can gather upon it and join hands."

DIRECTORY

OF THE

Agricultural and Similar Organizations in the State.

FEBRUARY, 1893.

STATE BOARD OF AGRICULTURE, 1893.

Members ex Officio.

His Excellency WM. E. RUSSELL.
His Honor ROGER WOLCOTT.
Hon. WM. M. OLIN, *Secretary of the Commonwealth.*
H. H. GOODELL, M.A., LL.D., *President Massachusetts Agricultural College.*

Members appointed by the Governor and Council.

	Term Expires
ELBRIDGE CUSHMAN of Lakeville (P. O. Middleborough),	1894
D. A. HORTON of Northampton,	1895
JAMES S. GRINNELL of Greenfield,	1896

Members chosen by the Incorporated Societies.

Amesbury and Salisbury (Agr'l and Hort'l),	F. W. SARGENT of Amesbury,	1894
Attleborough (Agr'l Assoc'n),	ISAAC ALGER of Attleborough,	1894
Barnstable County,	JOHN BURSLEY of West Barnstable,	1895
Bay State,	J. D. W. FRENCH of North Andover,	1896
Berkshire,	CHAS. A. MILLS of Southborough,	1894
Blackstone Valley,	HENRY A. COOK of Northbridge (P. O. Whitinsville),	1894
Bristol County,	N. W. SHAW of North Raynham,	1896
Deerfield Valley,	CHARLES E. WARD of Buckland,	1896
Eastern Hampden,	WM. HOLBROOK, M.D., of Palmer,	1894
Essex,	F. H. APPLETON of Peabody (P. O. Lynnfield),	1896
Franklin County,	J. C. NEWHALL of Conway,	1895
Hampden,	C. F. FOWLER of Westfield,	1894
Hampshire,	L. W. WEST of Hadley,	1895
Hampshire, Franklin and Hampden,	E. C. CLAPP of Northampton,	1894
Highland,	H. A. BARTON, Jr., of Dalton,	1896
Hillside,	WM. BANCROFT of Chesterfield,	1896
Hingham (Agr'l and Hort'l),	EDMUND HERSEY of Hingham,	1894
Hoosac Valley,	A. J. BUCKLIN of Adams,	1894
Housatonic,	J. H. ROWLEY of Egremont Plain,	1894
Marshfield (Agr'l and Hort'l),	L. S. RICHARDS of Marshfield (P. O. Marshfield Hills),	1894
Martha's Vineyard,	N. S. SHALER of Cambridge,	1895
Massachusetts,	HENRY S. RUSSELL of Milton,	1894
Massachusetts Horticultural,	E. W. WOOD of West Newton,	1894
Middlesex,	W. W. RAWSON of Arlington,	1894
Middlesex North,	A. C. VARNUM of Lowell,	1895
Middlesex South,	ISAAC DAMON of Wayland (P. O. Cochituate),	1896
Nantucket,	WM. W. McINTOSH of Nantucket,	1894
Oxford,	JOHN E. KIMBALL of Oxford,	1895
Plymouth County,	AUGUSTUS PRATT of North Middleborough,	1896
Spencer (Far's and Mech's Assoc'n),	EDWARD WARREN of Leicester (P. O. Spencer),	1895
Union (Agr'l and Hort'l),	G. C. ROWLEY of Blandford,	1895
Weymouth (Agr'l and Ind'l),	QUINCY L. REED of South Weymouth,	1894
Worcester,	C. L. HARTSHORN of Worcester,	1896
Worcester East,	W. A. KILBOURN of South Lancaster,	1894
Worcester North,	GEORGE CRUICKSHANKS of Fitchburg,	1896
Worcester North-west (Agr'l and Mech'l),	WM. H. BOWKER of Boston,	1895
Worcester South,	G. L. CLEMENCE of Southbridge (P. O. Globe Village),	1895
Worcester County West,	E. A. HARWOOD of North Brookfield,	1896

Secretary of the Board, WM. R. SESSIONS of Hampden.
Chemist to the Board, C. A. GOESSMANN, Ph.D., LL.D., of Amherst.
Entomologist to the Board, C. H. FERNALD, Ph.D., of Amherst.
Office of the Secretary, Commonwealth Building, Boston.

MASSACHUSETTS AGRICULTURAL COLLEGE.

Location, Amherst, Hampshire County.

BOARD OF TRUSTEES.

	Term Expires.
FRANCIS H. APPLETON of Peabody,	1894
WILLIAM WHEELER of Concord,	1894
ELIJAH W. WOOD of West Newton,	1895
CHAS. A. GLEASON of New Braintree,	1895
DANIEL NEEDHAM of Groton,	1896
JAMES DRAPER of Worcester,	1896
HENRY S. HYDE of Springfield,	1897
MERRITT I. WHEELER of Great Barrington,	1897
JAMES S. GRINNELL of Greenfield,	1898
JOSEPH A. HARWOOD of Littleton,	1898
WILLIAM H. BOWKER of Boston,	1899
J. D. W. FRENCH of North Andover,	1899
J. HOWE DEMOND of Northampton,	1900
ELMER D. HOWE of Marlborough,	1900

MEMBERS EX OFFICIO.

His Excellency Governor WM. E. RUSSELL,
President of the Corporation.

HENRY H. GOODELL, M.A., LL.D.,	*President of the College.*
JOHN W. DICKINSON,	*Secretary of the Board of Education.*
WILLIAM R. SESSIONS,	*Secretary of the Board of Agriculture.*

OFFICERS ELECTED BY THE BOARD OF TRUSTEES.

JAMES S. GRINNELL of Greenfield,	*Vice-President of the Corporation.*
WILLIAM R. SESSIONS of Hampden,	*Secretary.*
PROF. GEO. F. MILLS of Amherst,	*Acting Treasurer.*
CHARLES A. GLEASON of New Braintree,	*Auditor.*

BOARD OF OVERSEERS.

The State Board of Agriculture.

EXAMINING COMMITTEE OF THE BOARD OF AGRICULTURE.

Messrs. MILLS, VARNUM, HOLBROOK, CLEMENCE, CRUICKSHANKS and HARWOOD.

HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

HENRY H. GOODELL, M.A., LL.D.,	*Director.*
WILLIAM P. BROOKS, B.S.,	*Agriculturist.*
SAMUEL T. MAYNARD, B.S.,	*Horticulturist.*
CHARLES H. FERNALD, Ph.D.,	*Entomologist.*
CLARENCE D. WARNER, B.S.,	*Meteorologist.*

MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION.

Location, Amherst, Hampshire County.

Board of Control.

His Excellency Wm. E. Russell, Governor of the Commonwealth, *President ex officio.*

	Term Expires.
Wm. H. Bowker of Boston,	1895
Calvin L. Hartshorn of Worcester,	1894
Elected by the State Board of Agriculture.	
Elmer D. Howe of Marlborough,	1894
J. Howe Demond of Northampton,	1896
Elected by the Board of Trustees of the Massachusetts Agricultural College.	
Francis H. Appleton of Peabody,	1894
Elected by the Massachusetts Society for Promoting Agriculture.	
Wm. H. Porter of Agawam,	1895
Elected by the Massachusetts State Grange.	
William C. Strong of Newton (P. O. Waban),	1894
Elected by the Massachusetts Horticultural Society.	

Henry H. Goodell, M.A., LL.D., of Amherst, *President of the Massachusetts Agricultural College.*

Charles A. Goessmann, Ph.D., LL.D., of Amherst, *Director of the Station.*

William R. Sessions of Hampden, *Secretary of the State Board of Agriculture.*

Officers Elected by the Board of Control.

Henry H. Goodell, M.A., LL.D., of Amherst, . . *Vice-President.*

William R. Sessions of Hampden, . . *Secretary and Auditor.*

Charles A. Goessmann, Ph.D., LL.D., of Amherst, *Director, Chemist and Acting Treasurer.*

BOARD OF CATTLE COMMISSIONERS.

	Term Expires.
Levi Stockbridge of Amherst, *Chairman,*	1894
Chas. P. Lyman, F.R.C., V.S., of Boston, *Secretary,*	1893
Maurice O'Connell, D.V.S., of Holyoke,	1895

AGRICULTURAL SOCIETIES INCORPORATED BY SPECIAL ACT OF LEGISLATURE, AND REPRESENTED ON THE BOARD OF AGRICULTURE.

NAME.	PRESIDENT.	SECRETARY.	TREASURER.
Amesbury and Salisbury,*	D. C. Maxfield, Amesbury.	A. H. Fielden, Amesbury.	W. H. Dewhurst, Amesbury.
Attleborough (Agric'l Asso.),	S. O. Bigney, Attleborough.	George Randall, Attleborough.	G. H. French, North Attleborough.
Barnstable County,	John Simpkins, Yarmouth.	Fred C. Swift, Yarmouthport.	Albert F. Edson, Barnstable.
Bay State,†	J. D. W. French, North Andover.	C. M. Weld, Boston.	I. B. Sayles, Millbury.
Berkshire,	Walter Cutting, Pittsfield.	R. H. Cooke, Pittsfield.	J. P. Merrill, Pittsfield.
Blackstone Valley,	Wm. J. Taft, Uxbridge.	William L. Johnson, Uxbridge.	Arthur R. Taft, Uxbridge.
Bristol County,	Morgan Rotch, New Bedford.	A. B. Hodges, Taunton.	E. C. Holt, Taunton.
Deerfield Valley,	H. A. Howard, Colrain.	S. W. Hawkes, Charlemont.	H. N. Warner, Charlemont.
Eastern Hampden,	W. M. Tucker, Monson.	O. P. Allen, Palmer.	O. P. Allen, Palmer.
Essex,	Francis H. Appleton, Lynnfield.	J. M. Danforth, Lynnfield Centre.	G. L. Streeter, Salem.
Franklin County,	F. L. Whitmore, Sunderland.	Wm. S. Allen, Greenfield.	Wm. S. Allen, Greenfield.
Hampden,	F. E. Clark, Wilbraham.	Chas. A. Birnie, Longmeadow.	E. S. Batchelder, Springfield.
Hampshire,	William P. Brooks, Amherst.	H. C. Nash, Jr., Amherst.	H. C. Nash, Jr., Amherst.
Hampshire, Franklin and Hampden,	C. B. Lyman, Southampton.	W. H Riley, Northampton.	D. J. Wright, Northampton.
Highland,	M. J Smith, Middlefield.	J. McElwain, Middlefield.	M. J. Smith, Middlefield.
Hillside,	Alvan Barrus, Goshen.	William G. Atkins, West Cummington.	R. R. Packard, Cummington.
Hingham,*	E. L. Ripley, Hingham.	William H. Thomas, Hingham.	Reuben Sprague, Hingham.
Hoosac Valley,	A. C. Houghton, North Adams.	George F. Miller, North Adams.	M. R. Ford, North Adams.
Housatonic,	H. L. Rowe, Egremont	O. C. Bidwell, Great Barrington.	W. B. Sanford, Great Barrington.
Marshfield,*	G. W. Emery, Marshfield	Francis Collamore, North Pembroke.	Francis Collamore, North Pembroke.
Martha's Vineyard,	Henry L. Whiting, West Tisbury.	B. T. Hillman, Edgartown.	D. W. Mayhew, West Tisbury.
Massachusetts,	Thomas Motley, Jamaica Plain.	Francis H. Appleton, Lynnfield.	J. C. Rogers, Boston.
Middlesex,	W. W. Rawson, Arlington.	William H. Hunt, Concord.	B. W. Brown, Concord.
Middlesex North,	A. C. Varnum, Lowell.	E. T. Rowell, Lowell.	S. Drewett, Lowell.
Middlesex South,	Isaac Damon, Cochituate.	Edgar Potter, South Framingham.	C. J. Frost, Framingham.
Nantucket,	John S. Appleton, Jr., Nantucket.	J F. Murphey, Nantucket.	Asa C. Jones, Nantucket.
Oxford,	D. M. Howe, Charlton.	W. H. H. Thurston, Oxford.	W. H. H. Thurston, Oxford.
Plymouth County,	J. C. Swan, M.D., West Bridgewater.	George M. Hooper, Bridgewater.	Cyrus A. Lewis, Bridgewater.
Spencer (Farmers' and Mechanics' Association),	C. N. Prouty, Spencer.	F. B. Watson, Spencer.	A. W. Curtis, Spencer.
Union,*	J. J. Lloyd, Blandford.	E. W. Boise, Blandford.	W. J. Peebles, Blandford.

Weymouth (Ag'l and Ind.),	B. F. Poole, Rockland.	H. Wilbur Dyer, South Weymouth.	Gordon Willis, South Weymouth.
Worcester, ...	L. F. Herrick, Millbury.	John B. Bowker, Worcester.	John B. Bowker, Worcester.
Worcester East, . . .	John E. Thayer, Lancaster.	W. A. Kilbourn, South Lancaster.	Lucius Field, Clinton.
Worcester North, . .	George N. Proctor, Fitchburg.	S. W. Huntley, Fitchburg.	A. F. Whitney, Fitchburg.
Worcester North-west (Ag'l and Mechanical), . .	A. D. Raymond, Royalston.	James F. Whitcomb, Athol Centre.	T. H. Goodspeed, Athol Centre.
Worcester South, . .	George W. Wells, Southbridge.	C. V. Corey, Sturbridge.	C. V. Corey, Sturbridge.
Worcester County West, .	Charles G. Allen, Barre.	Matthew Walker, Barre.	Charles H. Follansby, Barre.

* And horticultural. † Incorporated under general laws.

HORTICULTURAL SOCIETIES.

NAME.	LOCATION.	PRESIDENT.	SECRETARY.
Hampden County, ...	Springfield, ...	J. E. Taylor, Springfield.	B. L. Bragg, Springfield.
Houghton, ...	Lynn, ...	J. W. Goodell, M.D., Lynn.	Frank W. Mace, Lynn.
Hyde Park, ...	Hyde Park, ...	H. J. Stockford, Hyde Park.	J. R. Andrews, Hyde Park.
Massachusetts,*	Boston, ...	N. T. Kidder, Milton,	Robert Manning, Boston.
Newton, ...	Newton, ...	D. D. Slade, Chestnut Hill.	L. H. Farlow, Newton.
Springfield Amateur, ...	Springfield, ...	Joseph Aumer, Springfield.	George H. Lapham, Springfield.
Wakefield,†	Wakefield, ...	Edwin C. Miller, Wakefield.	Mrs. J. F. Woodward, Wakefield.
Worcester County, ...	Worcester, ...	H. L. Parker, Worcester.	E. W. Lincoln, Worcester.

FARMERS' AND MECHANICS' ASSOCIATIONS.

Bolton, ...	Bolton, ...	H. F. Haynes, Bolton.	Geo. H. Brigham, Bolton.
Leominster, ...	Leominster, ...	A. L. Whitney, Leominster.	C. H. Rice, Leominster.
Middlesex and Worcester, ...	Hudson, ...	Francis Howe, Hudson.	Josiah S. Welsh, Hudson.
Needham, ...	Needham, ...	Joseph Smith, Needham.	A. K. Tisdale, Dover.
Oakham, ...	Oakham, ...	H. P. Austin, Oakham.	William S. Crawford, Oakham.
Princeton, ...	Princeton, ...	J. C. F. Mirick, Princeton.	J. E. Merrriam, Princeton.

* Incorporated and represented on the Board of Agriculture. † And agricultural.

FARMERS' AND MECHANICS' CLUBS.

NAME.	LOCATION.	PRESIDENT.	SECRETARY.
Ashby,	Ashby,	Geo. B. Simonds, Ashby.	E. A. Hubbard, Ashby.
Belchertown,	Belchertown,	S. Barton, Belchertown.	Eugene Randall, Belchertown.
Berlin,	Berlin,	P. B. Southwick, Berlin Centre.	J. D. Southwick, Berlin Centre.
Groton,	Groton,	Daniel Needham, Groton.	Charles Woolley, Groton.
Holden,	Holden,	F. C. Parker, Holden.	Franklin Moore, Holden.
Pepperell,	Pepperell,	G. G. Tarbell, East Pepperell.	S. R. Merrill, Pepperell.
Shirley,	Shirley,	E. G. Adams, Shirley.	- - -
Shrewsbury,	Shrewsbury,	E. A. Bartlett, Shrewsbury.	F. J. Stone, Shrewsbury
West Acton,	West Acton,	Isaac Reed, West Acton.	C. B. Stone, West Acton.
Wilmington,	Wilmington,	H. A. Harris, North-Wilmington.	E. M. Nichols, Wilmington.

FARMERS' CLUBS.

NAME.	LOCATION.	PRESIDENT.	SECRETARY.
Ashfield,	Ashfield,	E. D. Church. Ashfield.	Chas. A. Hall, Ashfield.
Boxborough,	Boxborough,	John Sherry, Boxborough.	J. F. Hayward, West Littleton.
Buckland,	Buckland,	R. W. Field, Shelburne Falls.	F. Forbes, Buckland
Chamberlain District,	Worcester,	B. W. Potter, Worcester.	S. A. Burgess, Worcester.
East Charlemont,	East Charlemont,	Charles H. Leavett, East Charlemont.	Reuben Streeter, East Charlemont.
Easthampton,	Easthampton,	L. E. Parsons, Easthampton.	George H. Parsons, Easthampton.
Franklin,	Franklin,	Chas. Badger, Franklin.	C. M. Allen, Franklin.
Halifax,	Halifax,	Otis Pratt, Halifax.	Mrs. J. S. Pope, Halifax.
Huntington,	Huntington,	C. H. Strong, Norwich.	H. W. Stickney, Norwich.
Lancaster,	Lancaster,	George W. Morse, South Lancaster.	F. A. Hanaford, South Lancaster.
Lunenburg,	Lunenburg,	C. E. Cox, Lunenburg.	James Hildreth, 2d, Lunenburg.
Marblehead and Swampscott,	Beach Bluff,	William Miller, Swampscott.	- - -
New Braintree,	New Braintree,	D. C. Wetherell, New Braintree.	E. W. Barr, New Braintree.
New Salem,	New Salem,	D. F. Carpenter, Millington.	Willard Putnam, Cooleyvillle.
North Raynham,	North Raynham,	- - -	N. W. Shaw, North Raynham.
North Westport,	North Westport,	E. L. Gifford, North Westport.	A. S. Sherman, North Westport.

Practical,	Egremont,	J. C. Taylor, Great Barrington.	Mrs. H. S. Potter, South Egremont.
Rehoboth,	Rehoboth,	Henry T. Horton, Rehoboth.	Ellery L. Goff, Rehoboth.
Rowley,	Rowley,	J. D. Dodge, Rowley.	T. P. Hale, Rowley.
Royalston,	Royalston,	A. D. Raymond, Royalston.	G. E. Pierce, Royalston.
Rutland,	Rutland,	Daniel Demond, Rutland.	Mrs. J. W. Munroe, Rutland.
Southborough,	Southborough,	Wm. H. Buck, Southborough.	D. C. McMasters, Southborough.
South Bristol,	New Bedford,	Franklyn Howland, Acushnet.	Geo. A. Potter, New Bedford.
South Deerfield,	South Deerfield,	E. W. Jackson, South Deerfield.	W. W. Sanderson, South Deerfield.
Sterling,	Sterling,	John P. Brittle, Clinton.	A. H. Sawyer, Sterling.
Tatnuck,	Worcester,	F. J. Kinney, Worcester.	Elliot Moore, Worcester.
Upton,	Upton,	G. H. Stoddard, Upton.	Robert A. Pierce, Upton.
Waltham,	Waltham,	M. R. Leonard, Waltham.	A. Starbuck, Waltham.
West Bridgewater,	West Bridgewater,	F. E. Howard, West Bridgewater.	Mrs. H. J. LeLacheur, W. Bridgewater.
West Brookfield,	West Brookfield,	S. N. Cutter, Warren.	L. H. Chamberlain, West Brookfield.
West Newbury,	West Newbury,	L. W. Bradley, West Newbury.	I. N. Lane, West Newbury.
West Peabody,	West Peabody,	D. A. Small, West Peabody.	Bertha G. Small, West Peabody.
Wilbraham,	Wilbraham,	James Richards, Wilbraham.	H. M. Bliss, Wilbraham.

MISCELLANEOUS.

Agricultural Library Association,	Swansea,	E. M. Thurston, South Swansea.	A. E. Arnold, Swansea Centre.
Boston Market Gardeners' Association,	Boston and vicinity,	W. W. Rawson, Arlington.	C. A. Learned, Arlington.
Bristol Co. Fruit Growers' Association,	Dighton,	Chas. N. Simmons, Dighton.	W. P. Eddy, Dighton.
Brockton Agricultural Society,*	Brockton,	H. W. Robinson, Boston.	Ira Copeland, Brockton.
Burlington Agricultural Society,	Burlington,	T. I. Reed, Burlington.	H. H. Nichols, Burlington.
Cranberry Growers' Association,	Cape Cod District,	J. J. Russell, Plymouth.	I. T. Jones, Sandwich
Farmers' and Gardeners' Club,	Hanson,	Geo. F. Simpson, Hanson.	F. S. Thomas, M.D , Hanson.
Franklin Harvest Club,	Connecticut Valley,	W. H. Loomis, Holyoke.	C. B. Lyman, Southampton.
Hampden Harvest Club,	Connecticut Valley,	The members alternately.	J. N. Bagg, West Springfield.
Westborough Agricultural Society,*	Westborough,	N. P. Brown, Westborough.	B. W. Hero, Westborough.
Young Men's Harvest Club,	Ludlow,	H. E. Miller, Ludlow.	E. N. Fisher, Ludlow.
Young People's Agricultural Club,	Wilbraham,	Lee W. Rice, Wilbraham.	Walter M. Bliss, Wilbraham.

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* Incorporated under general laws.

MASSACHUSETTS PATRONS OF HUSBANDRY.

OFFICERS OF THE STATE GRANGE, 1893.

Master,	E. D. Howe of Marlborough.
Overseer,	A. C. Stoddard of North Brookfield.
Lecturer,	J. W. Stockwell of Sutton.
Steward,	E. A. Emerson of Haverhill.
Assistant Steward,	Geo. L. Davis of Shrewsbury.
Chaplain,	Rev. C. S. Walker of Amherst.
Treasurer,	F. A. Harrington of Worcester.
Secretary,	W. C. Jewett of Worcester.
Gate Keeper,	C. H. Deming of Lanesborough.
Pomona,	Mrs. E. Cushman of Lakeville.
Flora,	Mrs. Minnie M. Chase of Medfield.
Ceres,	Mrs. C. E. Robinson of Hinsdale.
Lady Assistant Steward,	Mrs. F. L. Chamberlain of Greendale.

EXECUTIVE COMMITTEE.

H. A. Barton, Jr., of Dalton,	One year.
C. A. Dennen of Pepperell,	Two years.
Geo. L. Clemence of Southbridge,	Three years.

DEPUTIES.

A. A. Metcalf,	Holden.
A. C. Stoddard,	North Brookfield.
D. A. Horton,	Northampton.
Wesley B. Barton,	Dalton.
George A. Hastings,	Boylston Centre.
James Hildreth, 2d,	Lunenburg.
John W. Gifford,	South Westport.
N. B. Douglas,	Sherborn.
Elbridge Cushman,	Lakeville.
E. A. Emerson,	Haverhill.
F. A. Rist,	Montague.
Marcellus Boynton,	Westport.
Wm. N. Howard,	South Easton.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Pomona Granges.			
Middlesex and Norfolk, No. 1,	N. H. Fales, Pondville.	Rev. Daniel Round, Norfolk.	Mrs. Belle R. Clemons, Fayville.
Essex County, No. 2,	E. A. Emerson, Haverhill.	Stephen K. Fowler, W. Boxford.	J. Warren Mooar, Andover.
Middlesex and Worcester, No. 3,	James Hildreth, 2d, Lunenburg.	J. L. Harrington, Lunenburg.	Annie E. Robbins, Lowell.
Franklin and Worcester, No. 4,	Horace Drury, Athol Centre.	M. R. Hartshorn, Tully.	Flora J. Butterworth, Athol.
Worcester West, No. 5,	C. E. Bennett, Hubbardston.	L. Randall, North Dana.	Mrs. Mattie R. Knapp, North Dana.
District Granges.			
Berkshire County,	J. E. Seacord, Lenox.	A. H. Torrey, Williamstown.	W. B. Barton, Dalton.
Worcester West District,	C. E. Bennett, Hubbardston.	L. Randall, N. Dana.	Mrs. Mattie R. Knapp, N. Dana.
Worcester Central County,	A. A. Putnam, Sutton.	D. B. Rice, Shrewsbury.	G. A. Cheney, Worcester.
Borough District,	H. A. Gilmore, Westborough	Dr. Glazier, Hudson.	Mrs. Addison Keyes, Berlin.
Connecticut Valley District,	W. H. Bridgman, Belchertown.	Howard C. West, Belchertown.	Miss Sarah E. Mason, Northampton.
Worcester Southwest District,	W. H. Prince, Webster.	N. D. Ladd, Sturbridge.	A. M. Dodge, Charlton
Lancaster District,	Geo. A. Hastings, Boylston Centre.	W. A. Kilbourn, South Lancaster.	Mrs. Ida Cunningham, Lancaster.
Springfield District,	W. H. Porter, Agawam.	Dr. G. T. Ballard, Hampden.	Mrs. W. L. Phelps, Wilbraham.
Old Colony District,	Chas. C. Tinkham, Middleborough.	Elbridge Cushman, Middleborough.	Mrs. R. G. Buffinton, Fall River.
Mendon District,	Dr. N. Sanborn, Bellingham.	Clara M. Thayer, Blackstone.	Carrie E. Daniels, Blackstone.
Subordinate Granges.			
Northfield, No. 3,	T. R. Callendar, Northfield.	L. R. Smith, East Northfield.	Miss Mabel C. Lyman, East Northfield.
Groton, No. 7,	F. M. Boutwell, Groton.	Daniel Needham, Groton.	Mrs. Ellen M. Needham, Groton.
Barre, No. 9,	J. Hancock, Jr., Barre.	Mrs. S. E Smith, Barre.	Mrs. H. W. Harwood, Barre.
Amherst, No. 16,	Herbert Sabin, East Amherst.	Mrs. C. F. Morehouse, Amherst.	Miss Helen M. Smith, Amherst.
Hinsdale, No. 19,	F. F. Watkins, Hinsdale.	Mrs. F. F. Watkins, Hinsdale.	John S. Cole, Hinsdale.
Lanesborough, No. 21,	S. L. Miner, Lanesborough.	W. S. Royce, Lanesborough.	Charles H. Deming, Lanesborough.
Worcester, No. 22,	Charles Greenwood, Worcester.	Miss Etta M. Thayer, Worcester.	Miss Ellen M. Flagg, Worcester.
Dalton, No 23,	J. H. Smith, Dalton.	Mrs. W. H. Woodworth, Dalton.	M. Agnes Young, Dalton.
"Resolute" of Hatfield, No. 25,	Thaddeus Graves, Hatfield.	S. L. Cutler, Hatfield.	A. H. Graves, Hatfield.
Sterling, No. 53,	L. W. Rugg, Sterling.	Mrs. Alice M. Burpee, Sterling.	Agnes S. Kilburn, Sterling.
Auburn, No. 60,	H. J. Marcy, Auburn.	J. J. Allen, Auburn.	J. H. Prouty, Auburn.
"Union" of Belchertown, No. 64,	H. C. West, Belchertown.	Eugene Randall, Belchertown.	Mrs. Myron A. Ward, Belchertown.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Hardwick, No. 67,	W. A. Newcomb, Hardwick.	Mrs. W. A. Newcomb, Hardwick.	Susie B. Manly, Hardwick.
Phillipston, No. 70,	C. A. Moore, Phillipston.	J. W. Moore, Templeton.	Miss M. B. Hager, Templeton.
"Prescott" of Pepperell, No. 73,	W. F. Dennen, Pepperell.	A. N. Blood, Pepperell.	Emma J. Dennen, Pepperell.
Holden, No. 78,	A. A. Metcalf, Holden.	C. T. Mead, Holden.	Mrs. S. N. Hubbard, Holden.
Spencer, No. 79,	Edward Warren, Spencer.	J. H. Blanchard, Spencer.	P. Emerson, Spencer.
"Manhan" of Southampton, No. 82,	George K. Edwards, Southampton.	Rev. W. H. Adams, Southampton	Mrs. Geo. K. Edwards, Southampton.
North Orange, No. 86,	C. A. Peckham, Tully.	M. D. Herrick, North Orange.	Mrs. Ellen S. Prentice, Tully.
Lee, No. 88,	C. H. Shaylor, Lee.	C. O. Swift, Lee.	C: G. Hinckley, Lee.
Charlton, No. 92,	Carlos Bond, Rochdale.	Mrs. Mary Johnson, Charlton.	Fannie E. Burlingame, Charlton.
Grafton, No 93,	S. E. Stowe, Grafton.	Mrs. L. M. Rice, North Grafton.	Miss Eva B. Banister, Grafton.
Petersham, No. 95,	S. B. Cook, Petersham.	Lyman Randall, North Dana.	Mrs. R. J. Stone, Petersham.
Shrewsbury, No. 101,	Hiram W. Loring, Shrewsbury.	Mrs. L. E. Gates, Shrewsbury.	T. F. Marston, Shrewsbury.
Stow, No. 103,	F. H. Stevens, West Acton.	Mrs. F. H. Stevens, West Acton.	Mrs. U. M. Lewis, Stow.
"Garfield" of North Dana, No. 104,	J. E. Doubleday, North Dana.	E. A. Albee, North Dana.	Mrs. P. W. Estey, North Dana.
Marlborough, No. 105,	E. N. Stratton, Marlborough.	Miss Angie Dudley, Marlborough.	Miss Abbie A. Brigham, Marlborough.
West Boylston, No. 106,	W. C. Pierce, West Boylston.	Rosa Boynton, West Boylston.	Mrs. Geo. B. Newton, Oakdale.
Millbury, No. 107,	H. W. Carter, Millbury.	Mrs. E. G. Langdon, Millbury.	I. E. Howe, Millbury.
Hudson, No. 108,	R. H. Hapgood. Hudson.	Elvira J. Stone, Hudson.	Miss Mary E. Hall, Hudson.
Sutton, No. 109,	C. N. Woodbury, Sutton.	Dr. Edward Welch, Sutton.	Miss Sarah M. Mills, Sutton.
Sherborn, No. 110,	W. H. Rich, Sherborn.	C. O. Littlefield, South Sherborn.	A. L. Bickford, Sherborn.
Boylston. No. 111,	C. H. Hastings, Clinton.	Cora I. Hastings, Clinton.	Gertrude L. Shaw, Boylston.
"East Medway" of Millis, No. 112,	Geo. C. Thrasher, Millis.	Monroe Morse, Medway.	Mrs. E. F. Richardson, Millis.
Framingham, No. 113,	Harry B. Walkup, Framingham.	Mrs. L. Marston, Framingham.	Miss Mattie Hunt, Fayville.
Medfield, No. 114,	Susan M. Chase, Medfield.	George R. Chase, Medfield.	Miss Inez R. Clifford, Medfield.
Holliston, No. 115,	H. N. Rogers, Holliston.	James D. Fisher, Holliston.	Fannie J. Hayes, Holliston.
Westborough, No. 116,	Fred. P. Rogers, Westborough.	Mary C. Graham, Westborough.	Jennie W. Graham, Westborough.
Dover, No. 117,	Thomas McGill, Dover.	Miss S. E. Shumway, Dover.	Martha McGill, South Natick.
Southborough, No. 118,	W. Blanchard, Southborough.	J. E. S. Moore, Cordaville.	C. E. Cook, Jr., Southborough.
Northborough, No. 119,	Mrs. Mary S. Wood, Northborough.	E. S. Wood, Northborough.	Mrs. R. N. Mack, Northborough.

Lancaster, No. 120,	Calvin Maynard, Lancaster.	Mrs. A. M. L. Clark, Lancaster.	Mrs. E. T. Cunningham, Lancaster.
Sudbury, No. 121,	L P. Bent, Sudbury.	Chas. F. Gerry, Sudbury.	Emily F. Willis, Sudbury.
Templeton, No. 122,	P. F. French, Templeton.	G. R. Johnson, Templeton.	Lucien Gove, East Templeton.
Oxford, No. 123,	George L. Eddy, Oxford.	F. A. Clark, Oxford.	Walter A. Lovett, Oxford.
Ashland, No 124,	Henry C. Burnham, Ashland.	A. R. Stevens, Ashland.	Mrs. C. E. Adams, So. Framingham.
Upton, No. 125,	S. L. Madden, Milford.	Myrtice S. King, Upton.	Mrs. L. Jenny Chapman, West Upton.
Hubbardston, No. 126,	C. E. Bennett, Hubbardston.	J. F. Flagg, Hubbardston.	J. H. Allen, Hubbardston.
Amesbury, No. 127,	E. P. Sargent, Merrimac.	Mrs. B S. Gale, Amesbury.	Miss Nellie A. Huntington, Amesbury.
North Andover, No. 128,	Geo. A. Rea, North Andover.	Bessie A. Poor, North Andover Depot.	Lizzie F. Ingalls, North Andover.
Gardner, No. 130,	B. B. Goodale, Gardner.	Mrs. Lyra S. Knight, Gardner.	W. E. Knight, Gardner.
Boxborough, No. 131,	D. W. Cobleigh, West Littleton.	Mrs. L. C. Hager, West Acton.	J. F. Hayward, West Littleton.
North Brookfield, No 132,	D. C. Perkins, North Brookfield.	C. D. Richardson, West Brookfield.	Lizzie A. Doescher, North Brookfield.
West Dedham, No. 133,	Lucius Damrell, West Dedham.	Edith French, West Dedham.	Annie L. Richardson, West Dedham.
Berlin, No. 134,	H. A. Wheeler, Berlin.	Mrs. A. Keyes, Berlin.	Mrs. L. W. Brewer, Berlin.
Norfolk, No. 135,	A J Whiting, Pondville.	N H. Fales. Pondville.	M. N. Drayton, Norfolk.
Ipswich, No. 136,	Mary L. Kinsman, Ipswich.	Willard F. Kinsman, Ipswich.	F. A. Stackpole, Ipswich.
East Blackstone, No. 137,	Adrian Scott, Blackstone.	Addie M. Stearns, Blackstone.	Nancy A. Thayer, Blackstone.
Northampton, No 138,	Albert L. Phelps, Northampton.	Mrs. D. A. Horton, Northampton.	Miss. S. E. Mason, Northampton
East Sandwich, No. 139,	Jerome R. Holway, East Sandwich.	Samuel H. Nye, East Sandwich.	Mrs. Helen F. Holway, East Sandwich
West Boxford, No. 140,	C. F. Austin, West Boxford.	S. B. George, South Groveland.	Matilda B. Lund, West Boxford.
Montague, No. 141,	F. A. Rist, Montague.	F. L. Whitmore, Montague.	G. H. Goddard, Montague.
Bolton, No. 142,	Mrs. Mary F. Mentzer, Bolton.	Mrs. Geo. L. Taylor, Bolton.	Mrs. Clara S. Walcott, Bolton.
Mendon, No. 143,	Albert W. Gaskill, Mendon.	J. N. Nutter, Mendon.	S. Mabel Spofford, Mendon.
Franklin, No. 144,	John L. Fisher, City Mills.	Mrs. John L. Fisher, City Mills.	R. M. Handy, Franklin.
Douglas, No. 145,	J A. Williams, East Douglas.	Mary A. Richardson, Douglas.	T. M. Potter, Douglas.
West Newbury, No. 146,	L. W. Bradley, West Newbury.	Mrs. Lizzie Newell, West Newbury.	L. L. Jacques, West Newbury.
West Springfield, No. 147,	A. A. Sibley, West Springfield.	E. D. Taylor, West Springfield.	E. T. Sikes, West Springfield.
Swansea, No. 148,	S. G. Arnold, Swansea Village.	Mrs. Augusta Buffington, Swansea Centre	Etta L. Gardner, Swansea Centre.
Harvard, No. 149,	W. A. Mentzer, Harvard.	Mrs. W. A. Mentzer, Harvard.	Miss Abby T. Whitney, Ayer.
Concord, No. 150,	George P. Davis, Bedford.	A. W. Flint, Concord.	George Buttrick, Concord.
Agawam, No. 151,	E. L. Covill, Agawam.	Mrs. G. D. Fisk, Agawam.	Carrie S. Leonard, Agawam.
East Longmeadow, No. 152,	M. B. Sikes, Springfield.	E. M. Burt, East Longmeadow.	Geo. S. Wood, East Longmeadow.
Wilbraham, No. 153,	A. J. Blanchard, North Wilbraham.	Mrs. Frank Gurney, Wilbraham.	Mrs. W. L. Phelps, Wilbraham.
Haverhill, No. 154,	G. F. S. Webster, Haverhill.	Miss Lizzie H. Webster, Haverhill.	C. F. Marshall, Ayers Village.
Methuen, No. 155,	G. B. Bradley, Lawrence.	Frank Buckminster, Lawrence.	John S. Crosby, Methuen.
West Bridgewater, No. 156,	E. B. Wilbur, West Bridgewater.	Martha K. Crosby, Matfield.	Charles R. Packard, West Bridgewater.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Concluded.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Granby, No. 157,	W. S. Clark, Granby.	Mrs. W. S. Clark, Granby.	Mrs. A. J. Whitmarsh, Granby.
"Nemasket" of Middleborough, No. 158,	Wm. H. Elwell, Middleborough.	Mrs. Jas. M. Sampson, Middleborough.	L. C. Caswell, Lakeville.
"Green River" of Williamstown, No. 159,	S. A. Hickox, South Williamstown.	Miss Jennie Stearns, Williamstown.	Mrs. S. J. Kellogg, Williamstown.
South Hadley, No. 160,	I. N. Day, South Hadley.	C. A. Judd, South Hadley Falls.	Mrs. I. N. Day, South Hadley.
"Laurel" of West Newbury, No. 161,	I. T. Hibbs, West Newbury.	Gertrude Winship, Newburyport.	F. B. Prescott, West Newbury.
Dartmouth, No 162,	John W. Gifford, South Westport.	Henry M. Plummer, Dartmouth.	May L. Devoll, Dartmouth.
Dudley, No. 163,	C. L. Marsh, Webster.	D. S. Elliot, Dudley.	Geo B. Truell, Dudley.
Ware, No. 164,	J. H. Fletcher, Ware.	E. W. Barney, Ware.	F. H. Doane, Ware.
Hampden, No 165,	Geo. T. Ballard, Hampden	Elizabeth Beebe, Hampden.	Mrs. A. J. Tuttle, Hampden.
Wellesley, No. 166,	Charles F. Smith, Wellesley.	Abel F. Stevens, Wellesley.	Carolyn M. Chesbro, Wellesley Hills.
Somerset, No. 168,	Wm. H. Chace, Pottersville	Julia Synon, Pottersville.	Anna P. Chace, Pottersville.
Lunenburg, No. 169,	John H. Witherell, Lunenburg.	James Hildreth, 2d, Lunenburg.	Eliphalet Stone, Lunenburg.
New Braintree, No. 170,	J. B. Frost, New Braintree.	Horàtio Moore, New Braintree.	Mrs. Emma A. Moore, New Braintree.
Merrimac, No 171,	Willard B. Kelly, Merrimac.	Mrs. Edith E. McKay, Merrimac.	Homer R. Sargent, Merrimac.
Ashby, No. 172,	C. C. Damon, Ashby.	Ella Mayo, Ashby.	Mrs. S. L. Parker, Ashby.
Hopkinton, No. 173,	Elijah Fitch, Hopkinton.	Ella H. Lowe, Hayden Row.	Mrs. L. A. Ward, Hopkinton.
Brookfield, No. 174,	Walter B. Mellen, Brookfield.	Wm. F. Hayden, Brookfield.	Andrew A. Brigham, Brookfield.
Athol, No. 175,	S. C. Perham, Athol Centre.	O. P. Ellis, Athol Centre.	Mrs. Abbie A. Hill, Athol Centre.
"Miller's River" of Orange, No. 176,	John Dunbar, Orange.	James M. Crafts, Orange.	Mary A. Jerome, Orange.
Sturbridge, No. 177,	Geo. S. Ladd, Sturbridge	L. Ida Upham, Sturbridge.	Mrs. C. E. Ainsworth, Sturbridge.
Monson, No. 178,	A. F. Smith, Monson.	T. D. Rogers, Monson	C. S. Wood, Monson.
Ludlow, No 179,	Frank G Bennett, Ludlow.	Mrs. G. D. Atchinson, Indian Orchard.	Jennie I. Davis, Ludlow Centre.
West Brookfield, No. 180,	Wm. Burdick, West Brookfield.	Fred G. Smith, West Brookfield.	Jennie C. Preston, West Brookfield.
Westport, No. 181,	B. W. Allen, South Westport.	Cortez Allen, South Westport.	Marcellus Boynton, Central Village.
Southbridge, No. 182,	W. H. H. Cheney, Southbridge.	Hattie E. Morse, Southbridge.	W. C. Cady, Southbridge.
Andover, No. 183,	Edward W. Burtt, Andover.	Clara A. Putnam, Andover.	Angie M. Burtt, Andover.
Topsfield, No. 184,	Frank Towne, Topsfield.	B. J. Balch, Topsfield.	Mrs Mary E. Jackman, Topsfield.
North Attleborough, No 185,	H. P. Caldwell, North Attleborough.	Chas. J. Allen, North Attleborough.	Hattie F. Gardner, Abbot Run, R. I.

Fitchburg, No. 186, . . .	Capt. A. Eaton, Fitchburg.	Edna L. Putnam, Fitchburg.	Harry G. Morse, Fitchburg.
"Satuit" of Scituate, No. 187, .	George. W. Griggs, Norwell.	Fred S. Croning, Norwell.	C. O. Ellms, Greenbush.
Littleton, No. 188, . . .	C. L. Howard, Littleton Common.	H. W. Robbins, Littleton.	C. F. Watts, Littleton Common.
Warren, No. 189, . . .	Madison Weaver, Warren.	Effie M. Ball, Warren	H. A. Day, Warren.
Bellingham, No. 190, . .	C. E. White, Bellingham	Miss M. A. Billings, Bellingham.	Mrs. Alice Osborn, Bellingham.
Chestnut Hill, No. 191, . .	William O. Burdon, Millville.	Carrie E. Daniels, Blackstone.	Olive M. Aldrich, Millville.
Winchendon, No. 192, . .	C. W. Lord, Winchendon.	A. C. Streeter, Winchendon.	Geo. D. Smith, Winchendon.
Foxborough, No. 193, . .	James W. Alden, Foxborough.	Albert J. Daniels, Foxborough.	Miss Aurelia Buck, Foxborough.
Townsend, No. 194, . . .	E. A. Blood, Townsend.	Emma F. Gates, Townsend.	Vernal Barber, Townsend.
Royalston, No. 195, . . .	L. H. Woodbury, Royalston.	A. D. Raymond, Royalston.	Carrie W. Raymond, Royalston.
Easton, No. 196, . . .	Wm. N. Howard, South Easton.	Wm. Robinson, North Easton.	Mrs. W. B. Drew, North Easton.
"Brookville" of Holbrook, No. 197, ...	S. D. Chase, Holbrook.	T. H. West, Holbrook.	Ethel M. Bard, Holbrook.
Leominster, No. 198, . . .	F. L. Putnam, North Leominster.	A. H. Parkhurst, North Leominster.	F. K. Page, Leominster.

APPENDIX.

REPORT.

The following report has been transmitted to the secretary of the State Board of Agriculture by His Excellency the Governor, with the request that it be included in the "Agriculture of Massachusetts."

Report of the National Farmers' Congress at Lincoln, Neb., Nov. 22–24, 1892.

To His Excellency William E. Russell.

Having attended the twelfth annual session of the National Farmers' Congress, held at Lincoln, Neb., Nov. 22–24, 1892, as delegate from Massachusetts by Your Excellency's appointment, I take pleasure in forwarding a report of the Congress and my action in connection therewith.

The city of Lincoln celebrated its twenty-fifth anniversary the present year. In accordance with the census of 1890, it has a population of seventy thousand. It is a great commercial, educational and manufacturing centre.

The State capitol building, built of granite, some of which came from New England, is unique in its style, imposing in its proportions and convenient in its arrangement. The Congress held its sessions in Representative Hall, the Senate Chamber having been fitted up to display the varied fruits, cereals, roots and minerals of the great State of Nebraska. The city government of Lincoln had most tastefully decorated Representative Hall with patriotic emblems, and a grand welcome was extended, by Governor Boyd of Nebraska and Mayor Weir of Lincoln, in behalf of the State and city which they represented, to the visiting delegates who had gathered from nearly every State in the Union. The president of the Congress was the Hon. D. G. Purse of Savannah, Ga.; the Secretary, Hon. B. F. Clayton of Iowa.

The purpose of these annual national gatherings is, after radical discussion, to recommend legislation for the consideration of the National Congress at Washington, which shall benefit the varied agricultural industries of the country. Among the laws which have found embodiment in the statute books of the country originating in the agricultural Congress may be named that which provides a secretary of agriculture for the President's cabinet. The Interstate Commerce Commission was also the fruit of the agricultural Congress, and many other laws giving tone and vigor to commercial and agricultural interests have found their starting-point in earlier sessions of this national organization.

The subjects upon which addresses were delivered in the Congress of 1892 were: "The Transportation of Agricultural Products," by Hon. W. Pope Yeaman of Missouri; "The Beet Industry in the United States," by Prof. M. A. Lunn of Nebraska; "The Floral Interest," by Mrs. Robert A. McClellen of Alabama; "Success in Farming," by Mrs. Josephine Walker of Kansas; "Highway Transportation on Common Roads," by Hon. J. M. Stahl of Illinois and Hon. W. S. Delano of Nebraska; "The Agricultural College," by Pres. George F. Fairchild of Kansas; "Government Ownership of Railways," by Hon. H. C. Browne of Georgia; "Scientific Relation of Money to Business," by Hon. L. H. Welles of Iowa; "Agriculture in the South," by Gen. H. L. Burkitt of Mississippi and F. M. Clemanes of Kentucky; "Agricultural Experiment Stations," by President Fernald of Maine State College; and "Individuality of American Agriculture," by Daniel Needham of Massachusetts. After the delivery of these several addresses time was taken for radical discussion of the subjects which were presented in the essays read to the Congress.

One of the most important subjects discussed was the "Government Construction of Common Roads." The cost of construction of common roads over prairie land, such as are found in most of the agricultural States of the West, would be largely in excess of the building of equally good roads in New England, the Middle and Southern Atlantic States. Nature has poorly supplied material in the prairie States for such construction, and, with a sparsely settled country, the great cost is an absolute prohibition, if the means are to be supplied by local taxation. It was stated by the Hon. J. M. Stahl of Illinois that highway transportation in this country cost twenty-five cents per ton per mile, which is nearly two hundred per cent more than the average railway and water haul. He discussed the value of good roads in connection with public school education, showing, by statistics taken from a large field of observation, that bad roads reduced school attendance twenty-five per cent. In connection with the destructive influences of horses and carriages used in transportation, the cost over bad roads is more than trebled, and this without taking into account the loss of time of driver and team. There can be no doubt that the future welfare of the prairie farmer must depend largely upon the condition of the roads over which he is to transport the products of his land to a market.

A National Board of Agriculture was established by this Congress, and the following gentlemen were elected members of said Board: G. W. Swink of Colorado, Dennis Denyon of Illinois, G. M. River of Georgia, Gov. John Scott of Iowa, W. J. Bailey of Kansas, P. E. Dunham of Maine, Daniel Needham of Massachusetts, W. Pope Yeaman of Missouri, R. W. Furnas of Nebraska, A. T. Young of Pennsylvania, Chas. S. Flagg of Rhode Island, H. O. St. Clair of Oklahoma. The headquarters of this Board will be at Washington, and the general agricultural industries of the whole country will be studied, so that, if possible, no conflicting legislation will prejudice the interest of the several States.

Prof. M. C. Fernald of Maine read an exhaustive paper, setting forth the relation of science to practical agriculture. His statements were established by actual test made at government experiment stations.

In the address which I delivered upon the "Individuality of American Agriculture" I set forth by historical data the history in brief of the tiller of the soil in the old world under ancient and modern government, in his feeble but vain attempt to free himself from the bondage of surrounding conditions, and contrasted that condition with that of the American farmer, who maintains the individuality of citizenship, a comfortable and often a luxurious home, being able with the surplus products of his labor to so educate the children of his family that in mature years they are qualified to take the highest positions in social and public life.

I should not be just to the hospitality of Lincoln did I not mention the dinner given in honor of your delegate by persons connected with the University of Nebraska, to which the Governor of the State, the Chancellor of the University and many other distinguished citizens gathered, to recognize the valuable service of Massachusetts by her material helps in the diffusion of learning and the building up of facilities for public transportation in all parts of the United States.

It was voted to hold the next session of the Congress at Savannah, Ga., in November, 1893.

DANIEL NEEDHAM,
Delegate.

CATTLE COMMISSIONERS' REPORT.

To the honorable Senate and House of Representatives of the Commonwealth of Massachusetts, the undersigned Cattle Commissioners submit their annual report. The law of 1892, "To prevent the spread of tuberculosis," passed on the 22d of April, largely increased the responsibility and duty of our Board, and required trained experience and technical knowledge to enforce its provisions with despatch and equity to stock owners; and, by request of his Excellency, the gentlemen who at that time comprised it resigned their positions, and Levi Stockbridge of Amherst, Charles P. Lyman, F.R.C., V.S., professor of veterinary medicine in Harvard University, and Maurice O'Connell, D.V.S., of Holyoke, were appointed and qualified May 12, and entered upon the discharge of their duties; but the statistics of the work performed by the Board, which existed from January 1 to May 12, are embodied in this report, that the extent to which contagious disease has prevailed during the entire year, and the number of animals slaughtered, may be shown. After a thorough examination of the new law, and becoming satisfied of its intent and familiar with the various provisions by which that intent was to be secured, it was thought that the duties imposed by it upon the mayor and aldermen of cities, the selectmen of towns, and the inspectors, were such that a system could and should be devised by which positive information might be obtained of the number of cattle of all kinds domiciled in the State, and the extent to which the disease prevailed; and thus, while at work for its suppression, we would be able to gather positive facts to correct erroneous opinions, if such existed. Therefore circulars were prepared in which a system of work was outlined, and instructions given in relation to the methods by which the provisions of the law should be enforced, and sent to the officers named in every municipality in the Commonwealth, with the request that the work be performed promptly, and reports made to the commissioners.

The responses to these circulars came in very slowly, and it was found necessary to re-issue them in such change of form as the lapse of time required. The system devised, the form of the circulars issued, and the results obtained, will be found in the report of the secretary of the Board, which is embodied herein.

COMMONWEALTH OF MASSACHUSETTS.

BOARD OF CATTLE COMMISSIONERS,
SECRETARY'S OFFICE, 50 VILLAGE STREET, BOSTON, Dec. 28, 1892.

Board of Cattle Commissioners.

The secretary begs to make the following report: —

The newly appointed Board was organized on May 12; a meeting was held immediately, as a result of which the following circular was issued, and a copy was sent to the proper officers of every city and town in the Commonwealth.

COMMONWEALTH OF MASSACHUSETTS.

BOARD OF CATTLE COMMISSIONERS,
SECRETARY'S OFFICE, 50 VILLAGE STREET, BOSTON, May 23, 1892.

To Boards of Health of Cities and Towns.

GENTLEMEN: — You are hereby informed that the new Board of Cattle Commissioners has now been duly organized, and that its headquarters are at the School of Veterinary Medicine of Harvard University, 50 Village Street, Boston, to which place all general correspondence should be addressed.

The personal services of any member of the Board may be obtained by addressing him directly; and it will be found that this, in many instances, will save a considerable amount of valuable time.

Under a recent act of the Legislature all cities and towns are directed to appoint inspectors of "animals intended for slaughter or kept for the production of milk." Will you kindly favor this Board with the address or addresses of such inspector or inspectors in your district? Yours respectfully,

LEVI STOCKBRIDGE, *President*,
AMHERST, MASS.,
CHARLES P. LYMAN, V.S., *Secretary*,
50 VILLAGE ST., BOSTON, MASS.,
M. O'CONNELL, D.V.S.,
HOLYOKE, MASS.,
Board of Cattle Commissioners.

On June 2, because of numerous letters of inquiry from various towns, the following letter was written to the Attorney-General: —

Hon. ALBERT E. PILLSBURY.

DEAR SIR: — Under an act of the Legislature, approved, I believe, April 22 last, section one of chapter fifty-eight of th Public Statutes was amended so that the mayor and aldermen o cities and the selectmen of towns were directed to appoint, *in the month of April*, "one or more persons to be inspectors of provisions and of animals intended for slaughter or kept for the production of milk."

It has happened, because of a deemed improper notice, or for some other reason not given, that some of the cities and towns were unable to appoint during April, although they now write me that they would like to do so, if it were possible within the law; and one of them, the city of Newton, has asked whether it is not possible to obtain new legislation this year, so that the end may be accomplished.

It has also occurred, in one instance at least, that a town has not appointed inspectors under the act until after April, which appointment is, I suppose, illegal, and as a result of which, it seems to me possible that certain acts of the inspectors may get the towns into more or less difficulty.

Section 1 of chapter 58 of the Public Statutes reads, I believe, "The mayor and aldermen of cities and the selectmen of towns *may annually* appoint one or more persons," etc.

To save difficulty, and perhaps impossibility of obtaining further legislation in the matter this year, and to make cities and towns secure, is it possible, now that it is amended, to make appointments under section 1 of chapter 58?

In reply to this I received a very courteous letter from the Attorney-General, saying that, while the Board of Cattle Commissioners were not among those who were by law privileged to apply to his office in matters of the kind, he would be very glad to personally give any help that he could in the discharge of their duties.

Upon further consideration, the matter seemed to be one of so much doubt, and the Legislature still being in session, it was determined to apply for further legislation, and the following letter was written to his Excellency the Governor on June 6: —

Dear Sir: — I am in receipt, from the Attorney-General, of a copy of his communication of June 4 to you regarding the act to prevent the spread of tuberculosis, etc.

The new Board of Cattle Commissioners was organized May 12, and a copy of the enclosed circular was sent, upon May 23, to the proper authority in each city and town in the Commonwealth, of which there are some, three hundred and fifty-one; and up to this time no more than ninety-seven have responded. I take it that this means that a great many towns have failed to appoint inspectors under the act. If this is true, and I know that it is in several instances, the usefulness of the Cattle Commissioners, particularly in getting at the actual condition of these matters in the State, will be very much lessened during the coming year. With this act in full force I believe that the commission will be able to organize the work during the coming year in a way that will be entirely sufficient in protecting the consumers of meat and milk, will please and help those of our farmers who produce milk and healthy beef for market; and will be so far satisfactory to the authorities in certain of our neighboring States that they must withdraw the embargo, and the probable false impression, which they now maintain against our cattle.

I suppose that the difficulty of obtaining legislation at this late day is great; but this is a public health measure, and, under the circumstances at present existing, an important one *now*.

The Legislature evidently intended by their act to compel the cities and towns to appoint inspectors *immediately;* that they have not done so is evidently due to the exceedingly short notice; the law not going into force until the 22d of April of this year left them only eight days in which to act.

Following this on the sixteenth day of June the Legislature passed a measure which allowed a further time for appointment. Notice of this was given to the several towns. At this time the following circular letter of instruction to inspectors was issued from this office, and from time to time, as the addresses were received, a copy of it was sent to each one of the inspectors: —

COMMONWEALTH OF MASSACHUSETTS.

Board of Cattle Commissioners,
Secretary's Office, 50 Village Street, Boston, July, 1892.

The Board of Cattle Commissioners having been requested by several of the cities and towns of the Commonwealth to define the duties of the inspectors of " animals intended for slaughter or kept for the production of milk," so far as such duties relate to the business of this Commission, beg to present the following

Instruction to Inspectors.

Tuberculosis.

1. All herds within your district that are engaged in the production of milk that is to be marketed or sold, including milk or cream sold to creameries, or in which there are animals that are being fattened for beef, shall be thoroughly examined by you as often as once in each three months.

2. If they are found to be entirely free from disease, the same is to be certified by you upon a blank which will be furnished from this office, which blank shall be given to the owner of the herd, to be used by him for his own advantage. You will also send the required certificate to this office, and keep your own memorandum of the date and result of the inspection.

3. If, on the contrary, tuberculosis is found to exist in the herd, each animal showing it shall be isolated on the farm, or in some other convenient place to be selected by you, and quarantined there, under the authority of the local board of health, who shall at once notify the commissioners. The milk from such isolated animal shall not be sold, and in such instances the certificate of health shall not be given for the herd; or, if it has been previously given, it shall be withdrawn.

4. Quarantined animals must not be killed except by the permission of the board of health imposing such quarantine, and in your presence, as their inspector, or in the presence of an inspector appointed by them, who will at once certify the death to this office.

5. Whenever you have reason to believe that new and unsuspected animals have recently been introduced among a herd, or when from any reason, at any time, you have cause to suppose that disease exists in a herd, a reinspection shall be made at once, and the directions already given shall be followed.

Inspection of Meat.

1. Report to the commissioners the locations of all slaughter houses within your district; give the name of the butcher, the class of animals killed, the days of slaughter, and where the general market is sought.

2. As to the periodical inspection of these slaughter houses, and the destruction of any meat that may be considered unfit for human consumption, direction and action is to be taken from your local board of health.

3. When, however, tuberculosis is found to exist in a carcass, great endeavor is to be used to find the herd from whence the animal came, if the beef is of local production or otherwise, the town or State from whence it was procured, and a report as to the facts made to the commission.

General Suggestions.

1. If for any reason you desire to know the name and the address of the inspector for any town within this Commonwealth from which animals may have been removed to your district, you can obtain the same by reference to this office.

2. If during any of your inspections you find any cases of what is called, variously, actinomycosis, big jaw, wen, jaw ail, bone ail or sitfast, in cattle, kindly report its location.

3. Notify this Board of your action promptly.

4. Notify this office of the number of blank certificates that you will possibly require.

Levi Stockbridge, *President*,
Charles P. Lyman, *Secretary*,
M. O'Connell, D.V.S.,
Board of Cattle Commissioners.

The Law.

[Public Statutes, Chapter 58.]

Section 1. The mayor and aldermen of cities and the selectmen of towns may annually appoint one or more persons to be inspectors of provisions and of animals intended for slaughter. Such inspectors shall be sworn faithfully to discharge the duties of their office, and shall receive such compensation as the city council or the selectmen shall determine.

Sect. 2. Said inspectors may inspect all animals intended for slaughter, and all meats, fish, vegetables, produce, fruits, and provisions of all kinds, found in said cities or towns or exposed for sale or kept with intent to sell therein; and may for this purpose enter into all buildings or enclosures where said animals, meats, fish, vegetables, produce, fruits, or provisions are kept, stored, or exposed for slaughter or sale. When such animals, meat, fish, vegetables, produce, fruit, or provisions are found on such inspections to be tainted, diseased, corrupted, decayed, or unwholesome from any cause, said inspectors shall seize the same, and cause them or it to be destroyed or disposed of otherwise than for food; but if, at the time of the seizure, the owner of the property seized notifies in writing the inspector seizing the same of his desire to appeal to the board of health, said inspector shall cause said animals, meat, fish, vegetables, produce, fruit, or provisions to be inspected by said board of health, or by a committee thereof consisting of not less than two members; and if said board or committee find the same to be tainted, diseased, corrupted, or unwholesome, they shall order the same to be destroyed or disposed of otherwise than for food. If said board or committee do not so find, they shall order said animals, meat, fish, vegetables, produce, fruit, or provisions to be forthwith returned to the owner thereof. All moneys received by said inspectors or board of health for property disposed of as aforesaid shall, after deducting all expenses incurred by reason of such seizure, be paid to the owner of such property.

Sect. 3. Said inspectors may inspect all veal found in said cities or towns, or offered or exposed for sale, or kept with intent to sell therein, and if said veal is, in the judgment of the inspector, that of a calf killed under four weeks old, he shall seize the same and cause it to be destroyed or disposed of as provided in the preceding section, subject, however, to the provisions therein contained concerning appeal and the disposal of moneys.

Sect. 4. When complaint is made on oath to any police, district, or municipal court, or to a magistrate authorized to issue warrants in criminal cases, that the complainant believes that any diseased animals, or any tainted, diseased, corrupted, decayed, or unwholesome meat, fish, vegetables, produce, fruit, or provisions of any kind, or any veal of a calf killed under four weeks old, are kept or concealed in a particular house or place with the intent to kill, sell, or offer the same for sale for food, the court or magistrate, if satisfied there is reasonable cause for such belief, shall issue a warrant to search for such animals or articles, and all such warrants shall be directed and executed as provided in section three of chapter two hundred and twelve. If upon hearing, said court or magistrate determines that said animals or articles or any of them were kept or concealed for the purpose aforesaid, the same shall be destroyed or disposed of by the inspector, or by any officer designated by the court or magistrate according to the provisions of section two of this chapter; if the court or magistrate does not so determine, said animals or articles shall be returned to the owner.

Sect. 5. Whoever knowingly sells, or offers, or exposes for sale, or has in his possession with intent to sell for food, any diseased animal, or any tainted, diseased, corrupted, decayed, or unwholesome meat, fish, vegetables, produce, fruit, or provisions of any kind whatever, shall be punished by imprisonment in jail not more than sixty days, or by fine of not more than one hundred dollars.

Sect. 6. The place where property condemned under this chapter is found, and the name of every person in whose possession it is found, and of every person convicted of an offence under the preceding section, shall be published in two newspapers published in the county in which the property was found or the conviction took place.

Sect. 7. The provisions of this chapter shall not be in force in any city or town unless they are adopted by the city council of such city or the inhabitants of such town, or unless the provisions of chapter one hundred and eighty of the statutes of the year eighteen hundred and seventy-six have been already so adopted.

COMMONWEALTH OF MASSACHUSETTS.

In the Year One Thousand Eight Hundred and Ninety-two.

An Act

TO MORE EFFECTUALLY PREVENT THE SPREAD OF TUBERCULOSIS.

Be it enacted by the Senate and House of Representatives in General Court assembled, and by the authority of the same, as follows: —

Section 1. Section one of chapter fifty-eight of the Public Statutes is hereby amended by striking out the words "may annually" in the second line of said section and inserting in place thereof the words "shall annually in the month of April," also by inserting after the word "slaughter," in the third line of said section, the words "or kept for the production of milk," so as to read as follows: *Section 1.* The mayor and aldermen of cities and the selectmen of towns shall annually in the month of April appoint one or more persons to be inspectors of provisions and of animals intended for slaughter or kept for the production of milk. Such inspectors shall be sworn faithfully to discharge the duties of their office, and shall receive such compensation as the city council or the selectmen shall determine.

Sect. 2. Said inspectors, in addition to the powers conferred upon them by section two of chapter fifty-eight of the Public Statutes, may inspect all animals kept for the production of milk, and shall report to the board of cattle commissioners all suspected cases of tuberculosis which come to their notice among animals intended for slaughter or kept for the production of milk.

Sect. 3. Section thirteen of chapter two hundred and fifty-two of the acts of the year eighteen hundred and eighty-seven is hereby amended by inserting after the word "of" in the ninth line of said section the word "tuberculosis," and by adding at the end of said section the words "and may also pay a reasonable sum for the animal destroyed should a post mortem examination prove that said animal was free from the disease for which it was condemned," so as to read as follows: *Sect. 13.* When the commissioners, by an examination of a case of contagious disease among domestic animals, become satisfied that it has been contracted by intention or negligence on the part of the owner, or of a person in his employ, or by his consent, or by the use of food material liable to contain the germs of contagion, they shall cause such animals to be securely isolated at the expense of the owner, or they shall cause them to be killed without appraisal or payment; and in all cases of tuberculosis, farcy or glanders, the commissioner having condemned the animal infected therewith, shall cause such animal to be killed without an appraisal, but may pay the owner or any other person an equitable sum for the killing and burial thereof, and may also pay a reasonable sum for the animal destroyed should a post mortem examination prove that said animal was free from the disease for which it was condemned.

Sect. 4. Section seven of chapter fifty-eight of the Public Statutes is hereby repealed.

Sect. 5. This act shall take effect upon its passage.

Notwithstanding these efforts, there were so many towns that had not notified this office of the appointment, that on October 10 the following circular was sent: —

COMMONWEALTH OF MASSACHUSETTS.

Board of Cattle Commissioners,
Secretary's Office, 50 Village Street, Boston, Oct. 10, 1892.

To the Selectmen of the Town of ———

Gentlemen: — We have received no notice that you have, as yet, appointed an inspector under the act of 1892, entitled "An Act to more effectually prevent the spread of tuberculosis," which appointment is, you will notice, made *compulsory* by the act.

If the appointment has already been made, will you send the inspector's name and address to us *at once*. If it has not been made, will you remedy the failure, or give us your reason for not doing so without further loss of time.

Per order of the Board of Cattle Commissioners,
Charles P. Lyman, *Secretary*.

On December 3 several towns were still delinquent, and to these the following letter was sent: —

The name and address of the person appointed by you as inspector under the act of 1892, entitled "An Act to more effectually prevent the spread of tuberculosis," has not been received by us, notwithstanding the fact that you have been repeatedly notified by this Board to send such name and address. I am now instructed by the Board to demand that, if you have not already done so, you comply with the provisions of said act; and you are hereby directed to send the name and address of the inspector, so appointed, to this office without further loss of time.

These measures were so far successful that at the present writing (December 28) the appointments have been made by all of the towns except Palmer, Scituate, Southborough and Windsor.

Notwithstanding the fact that so many of the towns have appointed inspectors, a further difficulty has been met with in the fact that for various reasons, some of them explained, some of them not explained, the inspectors have neglected to make any return to this office of any work that they have done in the following two hundred and thirty-three towns: Acton, Acushnet, Adams, Agawam, Alford, Amherst, Ashburnham, Ashby, Ashfield, Avon, Barnstable, Barre, Becket, Bedford, Belchertown, Bellingham, Bernardston, Beverly, Billerica, Blandford, Bolton, Boston, Bourne, Boxborough, Boxford, Boylston, Bradford, Braintree, New Braintree, Brewster, Bridgewater, Brimfield, Buckland, Carlisle, Carver, Charlemont, Chatham, Chelmsford, Chelsea, Cheshire, Chester, Chicopee, Chilmark, Clarksburg, Cohasset, Colrain, Concord, Conway, Dalton, Dana, Danvers, Dartmouth, Dedham, Deerfield, Dennis, Douglas, Dracut, Dudley, East Bridgewater, Eastham, Edgartown, Egremont, Erving, Essex, Fairhaven, Falmouth, Fitchburg, Florida, Freetown, Gay Head, Georgetown, Gloucester, Gosnold, Granville, Great Barrington, Greenwich, Hampden, Hancock, Hanover, Hardwick, Harvard, Harwich, Hatfield, Haverhill, Hawley, Heath, Holbrook, Holden, Holland, Holyoke, Hopedale, Hubbardston, Hudson, Huntington, Hyde Park, Hyannis, Ipswich, Lakeville, Lancaster, Lanesborough, Lawrence, Lee, Leicester, Lenox, Leominster, Leverett, Lincoln, Littleton, Longmeadow, Lowell, Ludlow, Lynn, Lynnfield, Malden, Manchester, Marblehead, Marion, Mashpee, Mattapoisett, Medford, Methuen, Middlefield, Middleton, Milford, Millis, Monroe, Monson, Monterey, Montgomery, Mt. Washington, Nahant, Nantucket, Natick, New Ashford, Newbury, Newburyport, New Marlborough, New Salem, Norfolk, Northampton, North Andover, Northborough, North Reading, Norton, Norwell, Oakham, Otis, Oxford, Palmer, Paxton, Peabody, Peru, Petersham, Phillipston, Pittsfield, Plymouth, Plympton, Prescott, Princeton, Provincetown, Quincy, Raynham, Reading, Rehoboth, Revere, Richmond, Rochester, Rowe, Royalston, Russell, Rutland, Salem, Salisbury, Sandisfield, Saugus, Savoy, Scituate, Seekonk, Sharon, Sheffield, Shelburne, Sherborn, Shirley, Shrewsbury, Shutesbury, Southborough, Southbridge, South Hadley, Spencer, Springfield, Sterling, Stockbridge, Stoughton, Stow, Sturbridge, Sunderland, Sutton, Swampscott, Templeton, Tolland, Townsend, Truro, Tyringham, Upton, Wales, Waltham, Ware, Wareham, Warwick, Washington, Wellesley, Wendell, Wenham, West Boylston, West Bridgewater, West Brookfield, Westfield, Westford, Westminster, West Newbury, Westport, West Springfield, Weymouth, Whately, Wilmington, Winchendon, Winchester, Windsor, Winthrop, Woburn, Worcester, Wrentham, Yarmouth.

In the following one hundred and thirty-five towns they have not even applied for the necessary papers: Acton, Acushnet, Adams, Agawam, Ashburnham, Ashby, Barnstable, Barre, Becket, Bedford, Bernardston, Boston, Boxborough, Boxford, Bradford, Braintree, New Braintree, Brewster, Bridgewater, Buckland, Carlisle, Carver, Charlemont, Chatham, Chelmsford, Cheshire, Chester, Chicopee, Conway, Danvers, Dartmouth, Deerfield, Dennis, Douglas, Dracut, Dudley, Eastham, Edgartown, Erving, Fairhaven, Falmouth, Gay Head, Gosnold, Granville, Greenwich, Hampden, Hancock, Hardwick, Harvard, Heath, Holbrook, Hopedale, Hubbardston, Huntington, Hyannis, Lakeville, Lanesborough, Lawrence, Leicester, Lenox, Littleton, Longmeadow, Lowell, Ludlow, Lynn, Malden, Manchester, Marion, Mashpee, Medford, Middlefield, Middleton, Millis, Monroe, Montgomery, Mt. Washington, Nantucket, New Ashford, Newburyport, New Marlborough, New Salem, North Andover, Northborough, North Reading, Norton, Norwell, Otis, Oxford, Palmer, Peru, Pittsfield, Prescott, Princeton, Provincetown, Quincy, Raynham, Reading, Rehoboth, Revere, Richmond, Royalston, Russell, Rutland, Salem, Salisbury, Savoy, Scituate, Sherborn, Shutesbury, Southborough, South Hadley, Spencer, Sturbridge, Sunderland, Templeton, Tolland, Townsend, Tyringham, Wales, Wareham, Warren, Washington, Wendell, West Bridgewater, West Brookfield, Westfield, Westford, West Springfield, Weymouth, Whately, Winchendon, Windsor, Winthrop, Wrentham, Yarmouth.

In view of these unexpected hindrances, I am unable to make as full a report concerning the condition of the cattle throughout the State as it was hoped that by this time would be possible.

In the one hundred and eighteen towns from which returns have been received, 46,516 cattle have been examined; of these, 105 have been suspected of being affected with some contagious disease.

Respectfully submitted,
Charles P. Lyman, *Secretary.*

COMMONWEALTH OF MASSACHUSETTS.

Board of Cattle Commissioners,
Secretary's Office, 50 Village Street, Boston, Oct. 10, 1892.

To the Selectmen of the Town of ———.

Gentlemen:— Since the appointment by you of Mr. ——— as inspector, under the act of 1892, entitled "An Act to more effectually prevent the spread of tuberculosis," he has not applied to us for the necessary papers, as we have asked him to do by sending him our circular letter of instruction to inspectors; nor have we *any* knowledge that he has entered upon the discharge of his duties.

Will you kindly see that he at once complies with our requirements.

Per order of the Board of Cattle Commissioners,
Charles P. Lyman, *Secretary.*

It is regretted that the system adopted to gather statistical information of the number of cattle of all kinds kept in each of our municipalities, and the extent to which tuberculosis prevails in each, has failed of complete success, through the neglect of our city and town officers to discharge the duty assigned them by law. It is apparent that 45,516, though a very large number, is yet a small minority of all the neat stock of the State, yet enough to be taken as a fair representation of our cattle, so far as their health and exemption from tuberculosis is concerned. The official work of inspecting these cattle has been thoroughly done, and all cases of suspected disease reported to us. Of the 105 suspected cases examined by us, 81 were found to be tuberculous, and were destroyed. The per cent of disease thus found, though so very small, is sufficient to justify the strengthening of the law by the amendments herein proposed, and continued effort by the system which has been adopted.

GLANDERS.

This disease has been quite prevalent during the year, and with the same peculiarities of locality that have been noted in former reports. The number of animals destroyed by both boards in accordance with the provisions of law has been 134, which is less than the number killed in 1891; but we have reason to believe that, notwithstanding its illegality, many have been destroyed by the advice of practitioners, to avoid publicity and screen the stables of their owners from the suspicion of being infected with the disease.

HOG CHOLERA.

We have been notified of the existence of this disease in but four localities, on which, being sporadic in character, no action was taken but to cause strict isolation, and this has been effectual to prevent the spread of the disease to other herds.

Practical experience has convinced the Board that the law of 1892, "To prevent the spread of tuberculosis," could be made more effective, and would remove most of the difficulties we have encountered in its administration, if it were amended as follows: Give to *each* member of the commission power to quarantine a suspected animal, and to kill, or cause to be killed, any animal which he judges has an infectious or contagious disease. The mayor and aldermen of cities and the selectmen of towns should be made liable to a penalty if they refuse or neglect to appoint inspectors as the law provides; and the inspector who accepts the appointment and qualifies by taking the required oath should be liable to a penalty if he refuses or neglects to discharge his duty, or fails to comply with the order or instructions of the commissioners made in the discharge of their duty. Power should be given the commissioners to appoint agents at various points in the State, to aid them in the examination and final disposition of cases. Power should be given the commissioners to employ a clerk, at a moderate salary, to keep the records of the Board.

LEVI STOCKBRIDGE,
CHAS. P. LYMAN, *Sec.*,
M. O'CONNELL, D.V.S.,
Cattle Commissioners.

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PUBLIC DOCUMENT . . . . No. 33.

TENTH ANNUAL REPORT

OF THE

BOARD OF CONTROL

OF THE

STATE AGRICULTURAL EXPERIMENT STATION

AT

AMHERST, MASS.

1892.

BOSTON:
WRIGHT & POTTER PRINTING CO., STATE PRINTERS,
18 Post Office Square.
1893.

Commonwealth of Massachusetts.

Boston, Jan. 11, 1893.

To the Honorable Senate and House of Representatives.

In accordance with chapter 212 of the Acts of 1882 I have the honor to present the Tenth Annual Report of the Board of Control of the State Agricultural Experiment Station.

WM. R. SESSIONS,
Secretary.

MASSACHUSETTS STATE
AGRICULTURAL EXPERIMENT STATION,
AMHERST, MASS.

BOARD OF CONTROL, 1892.

HIS EXCELLENCY WILLIAM E. RUSSELL,
Governor of the Commonwealth, President ex officio.

W. H. BOWKER of Boston, ... Term expires, 1895.
C. L. HARTSHORN of Worcester, ... Term expires, 1894.
Appointed by the State Board of Agriculture.

J. H. DEMOND of Northampton, ... Term expires, 1896.
T. P. ROOT of Barre, ... Term expires, 1893.
Appointed by the Board of Trustees of the Massachusetts Agricultural College.

F. H. APPLETON of Peabody, ... Term expires, 1894.
Appointed by the Massachusetts Society for Promoting Agriculture.

W. H. PORTER of Agawam, ... Term expires, 1895.
Appointed by the Massachusetts State Grange.

WM. C. STRONG of Newton Highlands, . . Term expires, 1894.
Appointed by the Massachusetts Horticultural Society.

H. H. GOODELL, A.M., LL.D., Amherst,
President of the Massachusetts Agricultural College.

C. A. GOESSMANN, Ph D., LL D., Amherst,
Director of the Station.

WM. R. SESSIONS, Hampden,
Secretary of the State Board of Agriculture.

WM. R. SESSIONS, Hampden,
Secretary and Auditor.

C. A. GOESSMANN, Amherst,
Treasurer.

STATION STAFF.

C. A. Goessmann, Ph.D., LL.D., *Director and Chemist*,	Amherst.
J. B. Lindsey, Ph.D., *Associate Chemist (Feeding Department)*,	Amherst.
J. E. Humphrey, B.S.,* *Vegetable Physiologist (Mycologist)*,	Amherst.

Assistants.

R. B. Moore, B.S.,†	*General and Analytical Chemistry.*
C. S. Crocker, B.S.,	" " " "
H. D. Haskins, B.S.,	" " " "
C. H. Jones, B.S.,	" " " "
R. H. Smith, B.S.,	" " " "
E. B. Holland, B.S.,	" " " "
F. L. Arnold, B.S.,	*Field Experiments.*
C. H. Johnson, B.S.,	*Stock Feeding.*
David Wentzell,	*Farmer.*

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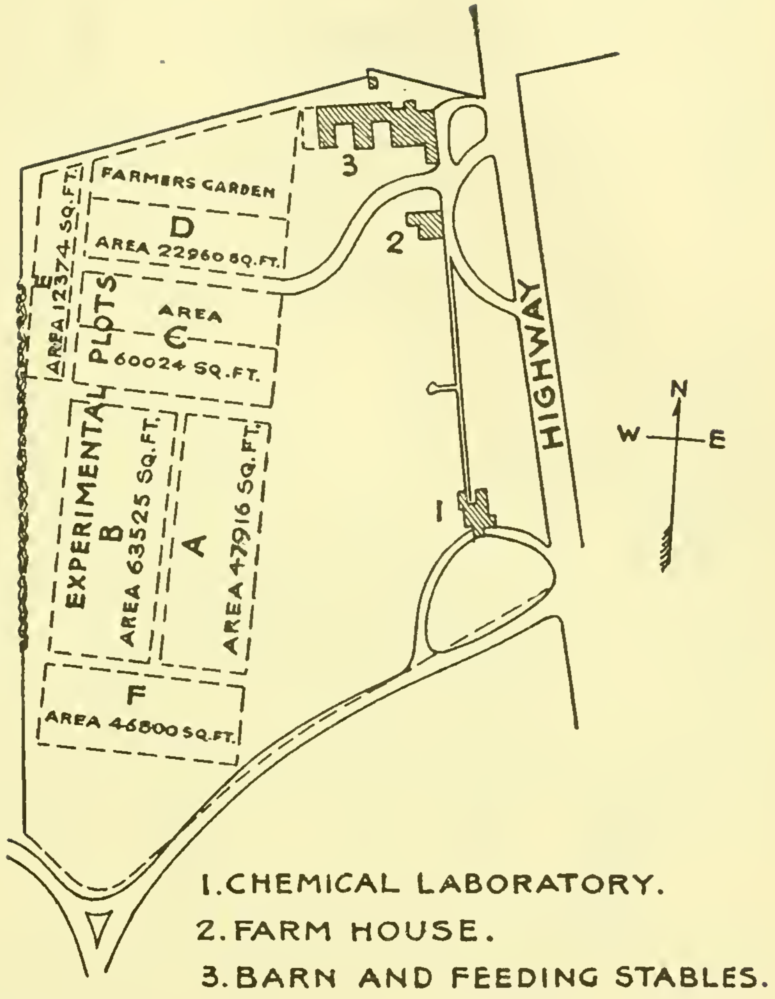
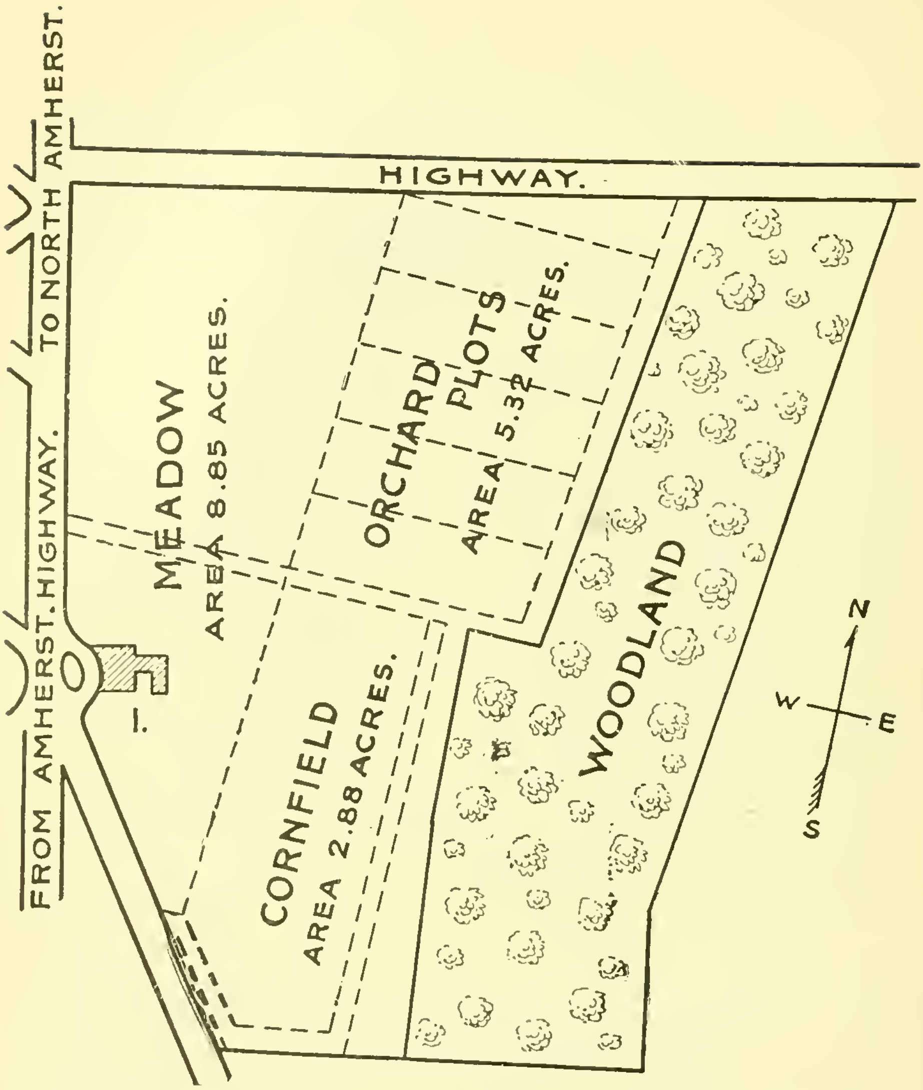
* Resigned Jan. 1, 1893.

† Resigned July 1, 1892.


FARMERS GARDEN
D
AREA 22960 SQ.FT.
E
AREA 12374 SQ.FT.
EXPERIMENTAL PLOTS
AREA
C
60024 SQ.FT.
B
AREA 63525 SQ.FT.
A
AREA 47916 SQ.FT.
F
AREA 46800 SQ.FT.
HIGHWAY
1
2
3
N
W
E

1. CHEMICAL LABORATORY.
2. FARM HOUSE.
3. BARN AND FEEDING STABLES.

·MAP·OF·LAND·LEASED·TO·THE·
·MASSACHUSETTS·EXPERIMENT·STATION·
·FROM·THE·
·AGRICULTURAL·COLLEGE·FARM·
·WEST·OF·THE·HIGHWAY·
·AREA·TAKEN··17.72·ACRES·


HIGHWAY.
TO NORTH AMHERST.
FROM AMHERST. HIGHWAY.
MEADOW
AREA 8.85 ACRES.
ORCHARD
PLOTS
AREA 5.32 ACRES.
CORNFIELD
AREA 2.88 ACRES.
WOODLAND
1.
N
W
E
S

1. AGRICULTURAL & PHYSIOLOGICAL LABORATORY.

MAP · OF · LAND · LEASED · TO · THE
MASSACHUSETTS · EXPERIMENT · STATION
· FROM · THE ·
AGRICULTURAL · COLLEGE · FARM
EAST · OF · THE · HIGHWAY
AREA · TAKEN · 30.52 · ACRES

TENTH ANNUAL REPORT OF THE DIRECTOR

OF THE

MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION,

AMHERST, MASS.

To the Honorable Board of Control.

GENTLEMEN: — The general condition of the State Agricultural Experiment Station may be considered to-day to be as satisfactory as at the close of the preceding year.

The buildings are on the whole in a fair state of preservation, considering their respective ages and previous conditions.

The arrangements for experiments in stock feeding have been improved in various directions, to provide for actual trials regarding the rate of digestibility of some new feed stuffs.

The number of silos has been increased to three, to admit of contemporaneous observations with different kinds of ensilage.

The outfit in apparatus of the chemical laboratory has been materially enlarged, to meet the growing demand for the analyses of dairy products, of imitations of butter, and of commercial feed stuffs.

A favorable season has contributed largely towards a satisfactory termination of a series of field experiments.

The different lines of observation from time to time presented for your consideration and endorsement have received their due attention to the full extent of existing resources, and as far as circumstances have rendered it practicable.

The co-operative tests in the vegetation house regarding the effect of different kinds and combinations of plant food on the general character of certain field and garden crops, as well as on certain characteristics of the roots of leguminous plants, have added a new and interesting feature to the work of the station.

Prof. J. E. Humphrey has continued his observations regarding certain diseases of garden crops and fruits. A description of his work concerning some diseases of the cucumber, the black-knot of the plum, etc., accompanied by interesting illustrations, form a part of this report, Part II., 10.

Dr. J. B. Lindsey, a graduate of the Massachusetts Agricultural College, and former assistant in the Massachusetts State Experiment Station, who has lately closed a three-years course of study at the University of Göttingen and Zurich, and whose services have been secured by a vote of the Board at the July meeting, has entered upon his duties as associate chemist. The supervision and management of the stock-feeding department has been assigned to him as his special duty.

The work carried on at the station during the past year, 1892, has been reported in detail upon the succeeding pages in the following order : —

PART I.

ON FEEDING EXPERIMENTS.

I. Feeding experiments with milch cows (two).

1. Winter feeding experiments with milch cows : —
   Dent corn *vs.* sweet corn.
   Corn meal *vs.* maize feed (Chicago).
2. Summer feeding experiments with milch cows : —
   Green feed : Rye, Canada peas and oats, summer vetch and oats, fodder corn and serradella.
   Grain feed : Wheat bran, Buffalo gluten feed, cotton-seed meal.
3. Creamery record of the station for 1891 and 1892.
4. Analyses of milk of different breeds of cows by Babcock mode.
5. Discussion on fodder articles and fodder supplies : —
   Home-raised fodder articles
   Commercial feed stuffs.
6. Analyses of fodder articles made at the station in 1892.

II. Feeding experiments with steers (two).
III. Feeding experiments with lambs.
IV. Feeding experiments with pigs (two).
V. Compilation of the amount of digestible nutrients consumed daily in the different feeding experiments made at the station, 1886–92, by Dr. J. B. Lindsey: —

1. Milch cows.
2. Steers.
3. Lambs.

Part II.

On Field Experiments and Observations in Vegetable Physiology and Pathology.

1. Field experiments to ascertain the effect of the exclusion of every form of nitrogen containing manurial matter from the fertilizer applied for the production of a leguminous crop, soja bean, on its yield per acre (Field A).
2. Field experiments with prominent varieties of grasses and with grass mixtures under fairly corresponding circumstances (Field B).
3. Field experiments regarding the effect of different combinations of commercial fertilizers on the yield of some prominent garden crops (Field C).
4. Observations regarding the adaptation of a variety of more or less reputed fodder plants new to our section of the country (Field D).
5. Field experiments with different commercial phosphates to study the economy of using the cheaper natural phosphates or the more costly acidulated phosphates (Field F).
6. Field experiments with mixed forage crops for green fodder and hay, vetch and oats, Canada peas and oats, soja bean, serradella, fodder corn (Fields G, H and I).
7. Observations on permanent grass lands (meadows).
8. Report on general farm work.
9 Report of Prof. James E. Humphrey on various diseases of plants, with observations in the field and vegetation house.

PART III.

SPECIAL WORK IN THE CHEMICAL LABORATORY.

I. Communication on commercial fertilizers.

1. General introduction.
2. Laws for the regulation of trade in commercial fertilizers.
3. List of licensed manufacturers and dealers from May 1, 1892, to May 1, 1893.
4. Analyses of licensed fertilizers (185).
5. Analyses of commercial fertilizers and manurial substances sent on for examination (114).
6. Miscellaneous analyses (9).

II. Analyses of milk sent on for examination (113).

III. Analyses of water sent on for examination (109).

IV. Compilation of analyses made at Amherst, Mass., of agricultural chemicals and refuse materials used for fertilizing purposes.

V. Compilation of analyses made at Amherst, Mass., of fodder articles, fruits, sugar-producing plants, dairy products, etc.

Meteorological Observations.

The periodical publications of the station have been as frequent as in preceding years; four bulletins, from ten to eleven thousand copies each, and eight circulars of official analyses, seven thousand copies each. The interest in these publications is steadily increasing on the part of farmers, and the growing interest of the press is well illustrated by our numerous exchanges of periodical publications from home and abroad, as may be seen from a subsequent statement.

It gives me pleasure, before concluding, to express to you my due appreciation of the faithful and substantial support I have received from all parties engaged with me in the work accomplished at the station. With the assurance of my sincere thanks for your kind encouragement and indulgence, permit me to sign,

Yours very respectfully,

C. A. GOESSMANN,

Director of the Massachusetts State Agricultural Experiment Station.

PART I.

ON

FEEDING EXPERIMENTS.

I. Feeding Experiments with Milch Cows (two).
II. Feeding Experiments with Steers (two).
III. Feeding Experiments with Lambs.
IV. Feeding Experiments with Pigs (two).
V. Compilation of the Amount of Digestible Nutrients consumed Daily in the Different Feeding Experiments.

I.

FEEDING EXPERIMENTS WITH MILCH COWS (TWO).

1891–92.

1. Winter feeding experiments with milch cows: —
   - Dent corn *vs.* sweet corn.
   - Corn meal *vs.* maize feed (Chicago).
2. Summer feeding experiments with milch cows: —
   - Green feed: Rye, Canada peas and oats, summer vetch and oats, fodder corn and serradella.
   - Grain feed: Wheat bran, Buffalo gluten feed, cotton-seed meal.
3. Creamery record of the station for 1891 and 1892.
4. Analyses of milk of different breeds of cows by Babcock's mode.
5. Discussion on fodder articles and fodder supplies.
   - Home-raised fodder articles.
   - Commercial feed stuffs.
6. Analyses of fodder articles made at the station in 1892.

Introduction. — From preceding annual reports it may be noticed that of late our attention has been directed towards actual feeding trials with a series of concentrated commercial feed stuffs comparatively new in our local markets. Their more general appearance in recent times rendered it desirable, in the interest of our dairy industry, to ascertain their comparative feeding effects, as well as their special economical merits, in our present conditions of food supplies for the production of milk and of meat.

These articles were as a rule compared with each other as well as with other standard feed stuffs, as far as practicable under otherwise corresponding circumstances. They were usually fed in connection with the same kinds of grain feed and of coarse fodder articles.

The results obtained with Chicago gluten meal, old and new process linseed meal, dried brewer's grain when fed in connection with corn meal or corn and cob meal or wheat bran or cotton-seed meal, or as substitutes of one or the other of these articles, have already been described in previous reports (VIII. and IX.).

During our last trials Chicago maize feed and Buffalo gluten feed have served as a new constituent of our grain feed ration for all classes of animals.

It has been our aim to secure genuine articles of both descriptions. The exceptionally high price of corn meal at the beginning of the year (thirty dollars a ton) rendered it advisable to look for some cheaper suitable commercial feed stuff, which might serve, in combination with other current, concentrated commercial feed stuffs, as a substitute for the former. Our results are on the whole quite encouraging, as may be seen from an examination of our subsequently described feeding experiments with various kinds of animals.

1. Winter Feeding Experiments with Milch Cows.

November, 1891, to March, 1892.

[Dent corn *vs.* sweet corn; corn meal *vs.* maize feed (Chicago).]

The experiments here under discussion were planned for the purpose of comparing the food value of a reputed variety of "dent corn" with that of a standard variety of "sweet corn," when used as the principal coarse fodder constituent in the daily diet of milch cows, either in the form of "ensilage," or, in a more advanced state of growth, in that of "stover." "Pride of the North" was selected as the representative of dent corns, and "Stowell's Evergreen" as that of sweet corns; both kinds of corn were used in all cases in corresponding stages of growth.

The exceptionally high market price of the corn meal at the beginning of our experiment (thirty-one dollars per ton of two thousand pounds) rendered its substitution in the daily diet of milch cows desirable for economical reasons. The Chicago variety of "maize feed" was chosen for that purpose. This comparatively new feed stuff is one of the waste products of corn obtained in connection with the manufacture of glucose sugar. The "maize feed" sold at the time at twenty-five dollars per ton of two thousand pounds. The commercial value of its fertilizing constituents, nitrogen, phosphoric acid and potash exceeded those contained in the corn meal from six to seven dollars per ton, making a difference at the time of twelve dollars in the *net cost* of both kinds of fine or grain feed. A successful attempt at using "maize feed" in place of corn meal in the daily diet of milch cows could not fail to secure a material reduction in *the net cost* of the grain feed portion of the *daily fodder ration.*

From six to eight cows, grades of various descriptions and of different milking periods, were selected for the trial. Some of these animals served a shorter period than others, on account of a too far advanced stage of lactation. Our record on this occasion is confined to four cows, which took part, with but one exception, from the beginning of observation.

1. *History of Cows.*

NAME OF COW.	BREED.	Age (Years).	LAST CALF DROPPED.	Daily Yield of Milk at Beginning of Trial (Quarts).	Number of Months on Trial.
Clarissa, .	Grade Shorthorn, .	8	June 2, 1891,	7–8	4
Cora, .	Grade Jersey, .	8	Mar. 14, 1891,	9–10	5
Lucy, .	Grade Ayrshire, .	6	Apr. 16, 1891,	11–12	5
Gem, .	Grade Shorthorn, .	5	Dec. 6, 1891,	14–15	3½

2. *Description of Fodder Articles.*

The *grain feed portion* of the daily diet consisted at different times either of *corn meal*, *wheat bran* and *maize feed* (Chicago), or of *maize feed*, *wheat bran* and *cotton-seed meal.* The mechanical condition of these various feed stuffs was good, and their chemical composition in every case a fair one, as may be seen from an abstract of the average result of our analyses. The Chicago maize feed was of a somewhat coarser texture than either of the other articles. It represents the dried grain residue of the maize kernels after the principal part of its starchy material has been removed, and contains more or less of the broken-up skins of the kernels.

Analyses of Fine Feed used.

[Grain Feed]

FOOD ANALYSES.	Corn Meal.	Wheat Bran.	Maize Feed.	Cotton-seed Meal.
Moisture at 100° C.,	13.26	10.01	8.70	7.05
Dry matter,	86.74	89.99	91.30	92.95
	100.00	100.00	100.00	100.00
Analyses of Dry Matter.				
Crude ash,	1.72	6.58	0.78	5.40
" cellulose,	2.28	11.77	7.97	6.15
" fat,	4.90	5.04	7.37	13.82
" protein,	12.94	18.06	27.55	38.79
Non-nitrogenous extract matter,	78.16	58.55	56.33	35.84
	100.00	100.00	100.00	100.00

Fertilizing Constituents.

[Nitrogen 15 cents, phosphoric acid 5½ cents, potassium oxide 4¼ cents, per pound]

FERTILIZER ANALYSES.	Corn Meal.	Wheat Bran.	Maize Feed.	Cotton-seed Meal.
Moisture,	13.26	10.01	8.70	7.05
Nitrogen,	1.79	2.60	4.03	5.77
Phosphoric acid,	0.71	2.85	0.70	2.33
Potassium oxide,	0.44	1.63	0.43	1.72
Valuation per 2,000 pounds,	$6.55	$12 40	$13 25	$21 42

The coarse feed-stuffs used in the daily diet consisted on this occasion either of a good English hay with sugar beets, or of one-fourth of a daily ration of a good English hay with all the ensilage the animal would consume, or of a well-cured corn stover. The hay consumed throughout the experiment was of the same fair quality.

The corn ensilage was obtained in part from a dent corn variety, " Pride of the North," and in part from a sweet corn variety, " Stowell's Evergreen." The same varieties of corn furnished the corn stover. Both kinds of corn were of a corresponding stage of growth when secured for the production of ensilage or of stover. In case of ensilage, the corn was cut in both cases when the kernels began to glaze; the whole plant was reduced to pieces from one to one and one-half inches in length, before being filled into the silo. The latter was filled as rapidly as the supply of material admitted. Both silos were covered in the same way (see previous report). They were of the same size and contained about the same quantity of cut ensilage corn (whole plant).

The corn stover was obtained in both instances from the matured crops, which were cut about ten days later than for ensilage. The ears were separated from the stalks and the latter carefully field-cured, and subsequently cut in a similar way as the ensilage for the silo, before being fed. The stover from sweet corn retained under otherwise corresponding circumstances more moisture than that from the dent corn; it was for this reason more liable to mould than the former. The ensilage from sweet corn was, however, fully equal in color and flavor to that from the dent corn. Both were highly relished by the animals on trial.

The chemical composition of the several coarse fodder articles used in our experiment is stated in the following tabular record: —

Analyses of Coarse Fodder Articles used.

FOOD ANALYSES.	Hay.	* Sweet Corn Stover.	† Dent Corn Stover.	* Sweet Corn Ensilage.	† Dent Corn Ensilage.	Sugar Beets.
Moisture at 100° C, .	9.72	41.62	20.10	84.30	79.92	85.27
Dry matter, . .	90.28	58.38	79.90	15.70	20.08	14.73
	100.00	100.00	100.00	100.00	100.00	100.00
Analyses of Dry Matter.						
Crude ash, . . .	6.43	9.76	6.12	6.32	4.99	5.95
" cellulose, . .	32.28	37.79	33.72	29.32	27.19	6.49
" fat, . . .	2.49	2.44	2.51	7.36	3.29	0.66
" protein, . .	9.54	6.08	7.75	7.86	8.29	10.97
Non-nitrogenous extract matter, . .	49.26	43.93	49.90	49.14	56.24	75.93
	100.00	100.00	100.00	100.00	100.00	100.00

* Stowell's Evergreen. † Pride of the North.

Fertilizing Constituents.

[Nitrogen 15 cents, phosphoric acid 5½ cents, potassium oxide 4½ cents, per pound.]

FERTILIZER ANALYSES.	Hay.	Sweet Corn Stover.	Dent Corn Stover.	Sweet Corn Ensilage.	Dent Corn Ensilage.	Sugar Beets.
Moisture, . . .	9.72	41.62	20.10	84.30	79.92	85.27
Nitrogen, . . .	1.38	0.57	0.99	0.20	0.27	0.26
Phosphoric acid, .	0.36	0.20	0.29	0.087	0.14	0.10
Potassium oxide, .	1.57	1.00	1.40	0.41	0.33	0.48
Valuation per 2,000 pounds, . . .	$5 95	$2 83	$4 55	$1 06	$1 26	$1 32

3. *Mode of Feeding.*

The time occupied by the experiment is divided into five feeding periods, varying from two to five weeks in length. The *total weight* of the *daily grain feed ration remained the same throughout the entire trial*, namely, *nine pounds*. This amount consisted during the first feeding period, November 8 to November 23, of three pounds each of maize feed (Chicago), wheat bran and corn meal, and during the remaining four feeding periods of three pounds each of Chicago maize feed, wheat bran and cotton-seed meal. One-half of the daily grain feed ration was fed at the time of milking in the morning with one-half of the coarse feed, and the other half with the remainder of the coarse feed at the milking time toward evening.

The *total* amount of the daily *coarse feed ration* depended on the individual appetite of the animals, and on the character of the fodder articles fed. During the first feeding period, when English hay and sugar beets constituted the daily coarse feed ration, the daily consumption of roots was limited per head in all cases to fifteen pounds, while the daily quantity of hay consumed was decided by the appetite of the animal, varying in case of different animals from twelve to sixteen pounds.

During the second and the third feeding periods nothing but corn stover served as coarse feed in the daily diet. The amount of stover from Stowell's Evergreen sweet corn consumed per day has varied in case of different animals from twelve and one-half to seventeen pounds per head; while the daily consumption of the stover obtained from the dent corn variety, Pride of the North, has varied per head from ten to thirteen and one-half pounds. The difference in the amount of both kinds of stover consumed is evidently mainly due to their different state of moisture, as may be noticed by comparing in both cases the total amount of dry matter contained in the daily diet consumed during the second and third feeding periods.

Corn ensilage and English hay constituted the coarse fodder of the daily diet during the fourth and fifth feeding periods. The amount of English hay fed per day in this connection was limited in all cases to five pounds per head; that of both kinds of the ensilage was governed by the appetite of each animal. Dent corn ensilage was fed in connection with English hay, as stated during the fourth feeding period, and the ensilage from the sweet corn during the fifth.

The daily consumption of the ensilage from the sweet corn varied per head in case of different animals from twenty-four to forty-three pounds, and that of the ensilage from the sweet corn from thirty-five to fifty-three pounds. This difference in the weights of both kinds of ensilage consumed in case of the same animal, is materially due to the same circumstance as has been pointed out previously with reference to similar facts noticed concerning the consumption of both kinds of corn stover. The ensilage of the dent corn contains twenty per cent. of dry vegetable matter and eighty per cent. of water, and the ensilage of the sweet sixteen per cent. of dry vegetable matter and eighty-four per cent. of water. The cows were watered twice a day, about two hours after feeding time.

The daily fodder rations below described represent the *average composition* of the daily diet used per head during the stated five succeeding feeding periods.

Average Composition of the Daily Fodder Rations used during the Five Successive Feeding Periods (1891–92).

I.

November 8 to November 23.

Corn meal (pounds),	3.00
Wheat bran,	3.00
Maize feed,	3.00
Hay,	14.35
Sugar beets,	15.00
Nutritive ratio,	1 : 6.65
Total cost (cents),	26.18
Manurial value obtainable,	9.48
Net cost,	16.70

II.

December 4 to December 23.

Wheat bran (pounds),	3.00
Maize feed,	3.00
Cotton-seed meal,	3.00
Sweet corn stover,*	14.56
Nutritive ratio,	1 : 4.61
Total cost (cents),	15.04
Manurial value obtainable,	7.29
Net cost,	7.75

III.

December 26 to January 13.

Wheat bran (pounds),	3.00
Maize feed,	3.00
Cotton-seed meal,	3.00
Dent corn stover,†	12.06
Nutritive ratio,	1 : 4.63
Total cost (cents),	14.42
Manurial value obtainable,	7.84
Net cost,	6.58

IV.

January 17 to February 23.

Wheat bran (pounds),	3.00
Maize feed,	3.00
Cotton-seed meal,	3.00
Hay,	5.00
Dent corn ensilage,	32.00
Nutritive ratio,	1 : 4.64
Total cost,	19.15
Manurial value obtainable,	8.46
Net cost,	10.69

V.

February 27 to March 23.

Wheat bran (pounds),	3.00
Maize feed,	3.00
Cotton-seed meal,	3.00
Hay,	5.00
Sweet corn ensilage,	41.39
Nutritive ratio,	1 : 4.80
Total cost (cents),	20.32
Manurial value obtainable,	8.60
Net cost,	11.72

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* Stowell's Evergreen.

† Pride of the North.

4. *Cost of Feed.*

The commercial valuation of the previously described daily average fodder rations during the five feeding periods of our experiment is based on the below-stated contemporary local price of the various fodder articles used in their composition: —

Local Market Cost per Ton of the Various Articles of Fodder used.

Corn meal,	$31 00
Wheat bran,	22 00
Maize feed,	25 00
Cotton-seed meal,	29 00
English hay,	15 00
Sweet corn stover,	5 00
Dent corn stover,	5 00
Sweet corn ensilage,	2 50
Dent corn ensilage,	2 50
Sugar beets,	5 00

Summary of Cost of the Above-stated Average Daily Fodder Rations used.

[Cents.]

	Feeding Periods.				
	I.	II.	III.	IV.	V.
Total cost,	26.18	15.04	14.42	19.15	20.32
Manurial value obtainable,	9.48	7.29	7.84	8.46	8.60
Net cost,*	16.70	7.75	6.58	10.69	11.72

* Allowing eighty per cent of the manurial value obtainable from the feed consumed.

Total cost of each daily ration represents the sum of the market cost of the quantity of the different fodder articles contained in that particular daily diet.

Net cost of a fodder article represents the cost of the article, less the commercial value of that portion of the various quantities of the different essential fertilizing constituents they contain which passes into the animal excretions, liquid and solid, and becomes thus available in the manurial refuse resulting from its consumption. The value of the manurial refuse obtainable from one and the same kind and quality of fodder article depends on the function, the kind and the age of the animal which consumes it. In case of milch cows it is conceded that an allowance of a loss of twenty per cent. covers the amount of nitrogen, phosphoric acid and potash which passes into the milk produced, and is thus lost as a manurial resource of the farm.

As our various fodder articles quite frequently differ widely from each other with reference to the amount of nitrogen, phosphoric acid and potash they contain, it is but natural that the obtainable manurial value of our different fodder articles under otherwise corresponding circumstances must differ also more or less seriously. The more phosphoric acid, potash and in particular nitrogen a given quantity of a fodder article contains, the more valuable, considered from a commercial stand-point, is the manurial refuse resulting from its use. The subsequent abstract of our fertilizer analyses of the different fodder articles used on the present occasion may well serve as an illustration of the previous statements.

Commercial Valuation of Essential Constituents contained in the Various Articles of Fodder used.

[Nitrogen 15 cents, phosphoric acid 5½ cents, potassium oxide 4½ cents, per pound.]

FERTILIZER ANALYSES.	Corn Meal.	Wheat Bran.	Maize Feed (Chicago).	Cotton-seed Meal.	English Hay.	Sweet Corn Stover.	Dent Corn Stover.	Sweet Corn Ensilage.	Dent Corn Ensilage.	Sugar Beets.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Moisture,	13.26	10.01	8.70	7.05	9.72	41.62	20.10	84.30	79.92	85.27
Nitrogen,	1.79	2.60	4.03	5.77	1.38	0.57	0.99	0.20	0.27	0.26
Phosphoric acid,	0.71	2.85	0.70	2.33	0.36	0.20	0.29	0.087	0.14	0.10
Potassium oxide,	0.44	1.63	0.43	1.72	1.57	1.00	1.40	0.41	0.33	0.48
Valuation per 2,000 pounds,	$6 55	$12 40	$13 25	$21 42	$5 95	$2 83	$4 55	$1 06	$1 26	$1 32
Per Ton of 2,000 Pounds.										
Market cost,	$31 00	$22 00	$25 00	$29 00	$15 00	$5 00	$5 00	$2 50	$2 50	$5 00
Manurial value obtainable,*	5 24	9 92	10 60	17 14	4 76	2 26	3 64	0 85	1 01	1 06
Net cost,	25 76	12 08	14 40	11 86	8 24	2 74	1 36	1 65	1 49	3 94

* Allowing a loss of twenty per cent. contained in the milk sold.

From previous discussions it will be noticed that the different fodder rations used during the five feeding periods of our last experiment varied seriously in regard to *market cost* as well as to *net cost.* To what particular circumstance this result is due deserves some special attention. Whether it is due to the cost of the grain feed or to that of the coarse feed, and to what extent in either case, is shown in the subsequent tabular statement.

Statement of the Cost of Fine and Coarse Feed Portion of the Daily Fodder Rations used.

Fine Feed.

[Cents.]

	FEEDING PERIODS.				
	I.	II.	III.	IV.	V.
Total cost, ...	11.70	11.40	11.40	11.40	11.40
Manurial value obtainable, .	3.90	5.65	5.65	5.65	5.65
Net cost, ...	7.80	5.75	5.75	5.75	5.75

Coarse Feed.

[Cents.]

	I.	II.	III.	IV.	V.
Total cost, ...	14.51	3.64	3.02	7.75	8.92
Manurial value obtainable, .	5.65	1.65	2.20	3.30	3.45
Net cost, ...	8.86	1.99	0.82	4.45	5.47

The market cost of our grain feed ration is materially the same in all cases; the high manurial value of maize feed and cotton-seed meal (II., III., IV., V.), as compared with that of corn meal (I.), makes the net cost of the former two cents less than that of the latter. The pecuniary advantages arising from an intelligent use of corn stover and corn ensilage in the dairy industry, in place of English hay, deserve particular attention. In view of these results, it may not be out of place to repeat a former advice: —

"The high market price of two of our most prominent home-raised coarse fodder articles, first and second cut of upland meadow, English hay and rowen, affects seriously the degree of our financial results in the production of milk, as far as the cost of feed is concerned. We are in need of a cheaper source of supply of coarse fodder substances than a considerable proportion of our grass lands, pastures and meadows, in their present state of productiveness, can claim to be. More satisfactory results can be obtained, no doubt, in many cases by turning indifferently yielding dry grass lands, if at all capable of higher cultivation, to account for the production of some other suitable fodder crops than grasses. The good services of dry fodder corn, corn stover and a good corn ensilage, for a more economical production of milk, are deservedly from day to day more generally recognized. However gratifying this fact will be considered, it is not advisable, in the light of past experience, in a general farm management to raise one fodder crop at the exclusion of all others, however lucrative at the time this practice may prove; such course can at best only offer a temporary relief. The introduction of a greater variety, in particular of annual reputed fodder crops, promises a more permanent improvement in fodder supply. Such course wherever adopted has not only resulted in cheapening the production of milk and beef, but has proved to be a most economical way to raise the general productiveness of farm lands to a higher standard."

Our local experience with a variety of annual leguminous fodder crops, as vetches, cow-peas, serradella and soja bean, has been very encouraging. The satisfactory results obtained in previous years are fully confirmed year after year. We are raising the present season vetch and oats, Canada peas and oats, soja beans and serradella, partly for green fodder and for ensilage, and partly for hay.

Quantity of Milk produced per Day (Quarts).

[One quart equals 2.15 pounds.]

	Feeding Periods.					General Average.	Extreme Variations.
	I.	II.	III.	IV.	V.		
Clarissa, .	7.18	5.76	4.88	4.52	–	5.59	3.72– 8.37
Cora, .	8.57	7.29	6.68	6.17	5.39	6.82	4.65– 9.77
Lucy, .	9.68	8.00	7.73	7.73	7.79	8.19	6.51–10.70
Gem,. .	–	13.46	–	13.18	12.31	12.98	11.63–15.11

Considering the period of lactation in the case of each animal, the decline in yield of milk as the time of observation advances seems to be normal. Cow No. 4, "Gem," was somewhat indisposed during the third feeding period, refusing for a week or two to eat her customary amount of feed; the yield of milk fell off, and is for this reason not recorded here. As soon as she began to consume again the regular fodder ration, the yield of milk with reference to quantity was normal; yet its quality had suffered a serious change in solids, as will be noticed from the following record of analyses of morning's milk: —

Analyses of Milk during Different Feeding Periods.

[Per Cent.]

1891-92.	CLARISSA.		CORA.		LUCY.		GEM.	
	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.
Period II.: —								
December 8, .	15.12	5.96	14.06	5.17	13.68	4.66	–	–
December 15, .	13.96	5.15	13.39	4.34	12.81	4.77	13.93	4.91
December 22, .	15.50	5.61	13.65	4.73	13.67	4.67	14.49	5.10
Period III.: —								
December 29, .	14.09	5.02	13.03	4.37	13.63	4.43	13.19	4.16
January 5, .	13.95	4.62	13.21	4.21	14.14	5.05	–	–
January 12, .	14.55	4.72	14.04	4.66	13.53	4.38	–	–
Period IV.: —								
January 19, .	13.96	4.66	13.77	4.69	14.04	5.42	11.63	3.48
January 26, .	13.19	4.11	12.71	4.15	13.63	4.79	11.11	3.38
February 2, .	13.93	4.47	13.97	4.72	13.84	4.73	11.94	3.55
February 9, .	14.07	5.18	13.06	4.34	14.50	5.32	11.64	3.49
February 16, .	13.29	4.57	13.63	4.77	14.16	5.18	12.06	3.58
February 22, .	13.89	4.92	14.05	4.84	13.65	4.56	12.06	3.56
Period V.: —								
March 1, .	–	–	13.38	4.45	13.82	4.51	12.23	3.56
March 8, .	–	–	14.00	4.80	14.10	5.08	12.15	3.66
March 15, .	–	–	14.34	5.41	12.82	4.09	11.99	3.56
March 22, .	–	–	13.83	4.67	14.11	4.78	11.60	3.27

Live Weight of Animals during the Feeding Periods.

[Pounds]

	FEEDING PERIODS.					Gain at Close.
	I.	II.	III.	IV.	V.	
Clarissa, ...	951	966	957	999	–	48
Cora, ...	1,062	1,042	1,051	1,062	1,069	7
Lucy, ...	850	815	816	808	804	—46
Gem, ...	–	869	–	856	865	—4

The general condition of the animals at the close of the observation was a satisfactory one.

Conclusions.

A careful consideration of the previously recorded results leads us to the following conclusions: —

1. The substitution of a ration composed of three pounds each of corn meal, maize feed and wheat bran, by one consisting of three pounds each maize feed, wheat bran and cotton-seed meal, *has in our case not materially changed the market cost of the grain feed ration, but reduced two cents its net cost, in consequence of the more valuable manurial refuse of the latter.*

2. The quantity and quality of milk has not been affected in any noticeable degree by the change in the grain feed ration in case of healthy animals.

3. The differences in the cost, *both market and net, of the different fodder rations, are in a controlling degree due to the cost of the different coarse fodder articles used, — a fact which has been repeatedly pointed out in previous communications.*

FEEDING RECORD.

Clarissa.

FEEDING PERIODS.	FEED CONSUMED (POUNDS) PER DAY.										Total Amount of Dry Matter consumed per Day (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal (Pounds).
	Corn Meal.	Wheat Bran.	Maize Feed.	Cotton-seed Meal.	Hay.	Sweet Corn Stover.	Dent Corn Stover.	Sweet Corn Ensilage.	Dent Corn Ensilage.	Beets.					
1891-92.															
Nov. 8 to Nov. 23,	3.00	3.00	3.00	–	16.00	–	–	–	–	15.00	24.68	7.18	3.44	1:6.71	951
Dec. 4 to Dec. 23,	–	3.00	3.00	3.00	–	17.05	–	–	–	–	18.18	5.76	3.16	1:4.90	966
Dec. 26 to Jan. 13,	–	3.00	3.00	3.00	–	–	13.28	–	–	–	18.84	4.88	3.86	1:4.78	957
Jan. 17 to Feb. 23,	–	3.00	3.00	3.00	5.00	–	–	–	43.32	–	21.43	4.52	4.74	1:4.96	999

Cora.

Nov. 8 to Nov. 23,	3.00	3.00	3.00	–	11.73	–	–	–	–	15.00	20.83	8.58	2.43	1:6.41	1,062
Dec. 4 to Dec 23,	–	3.00	3.00	3.00	–	12.32	–	–	–	–	15.42	7.29	2.11	1:4.38	1,042
Dec. 26 to Jan. 13,	–	3.00	3.00	3.00	–	–	9.78	–	–	–	16.04	6.68	2.40	1:4.35	1,051
Jan. 17 to Feb. 23,	–	3.00	3.00	3.00	5.00	–	–	–	26.65	–	18.09	6.17	2.93	1:4.49	1,062
Feb. 27 to Mar. 23,	–	3.00	3.00	3.00	5.00	–	–	34.56	–	–	18.17	5.39	3.37	1:4.64	1,069

FEEDING RECORD — *Concluded.*

Lucy.

FEEDING PERIODS.	FEED CONSUMED (POUNDS) PER DAY.										Total Amount of Dry Matter consumed per Day (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal (Pounds).
	Corn Meal.	Wheat Bran.	Maize Feed.	Cotton-seed Meal.	Hay.	Sweet Corn Stover.	Dent Corn Stover.	Sweet Corn Ensilage.	Dent Corn Ensilage.	Beets.					
1891-92.															
Nov. 8 to Nov. 23,	3.00	3.00	3.00	–	15.33	–	–	–	–	15.00	24.08	9.69	2.49	1:6.69	850
Dec. 4 to Dec. 23,	–	3.00	3.00	3.00	–	13.47	–	–	–	–	16.09	8.00	2.01	1:4.51	815
Dec. 26 to Jan. 13,	–	3.00	3.00	3.00	–	–	13.11	–	–	–	18.70	7.43	2.52	1:4.76	816
Jan. 17 to Feb. 23,	–	3.00	3.00	3.00	5.00	–	–	–	23.68	–	17.49	7.73	2.26	1:4.41	808
Feb. 27 to Mar. 23,	–	3.00	3.00	3.00	5.00	–	–	37.20	–	–	18.58	7.79	2.39	1:4.70	804

Gem.

Dec. 10 to Dec. 23,	–	3.00	3.00	3.00	–	15.39	–	–	–	–	17.21	13.46	1.27	1:4.71	869
Dec. 26 to Jan. 13,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Jan. 17 to Feb 23,	–	3.00	3.00	3.00	5.00	–	–	–	34.35	–	19.64	13.18	1.49	1:4.71	856
Feb. 27 to Mar. 23,	–	3.00	3.00	3.00	5.00	–	–	53.40	–	–	21.12	12.31	1.71	1:5.09	865

TOTAL COST OF FEED PER QUART OF MILK.

Clarissa.

FEEDING PERIODS.	Total Quantity of Milk produced (Quarts).	Average Daily Yield of Milk (Quarts).	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Maize Feed consumed (Pounds).	Total Amount of Cotton-seed Meal consumed (Pounds).	Total Amount of Hay consumed (Pounds).	Total Amount of Sweet Corn Stover consumed (Pounds).	Total Amount of Dent Corn Stover consumed (Pounds).	Total Amount of Sweet Corn Ensilage consumed (Pounds).	Total Amount of Dent Corn Ensilage consumed (Pounds).	Total Amount of Beets consumed (Pounds).	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk (Cents).
1891-92.														
Nov. 8 to Nov. 23, .	107.75	7.18	45.00	45.00	45.00	–	240.00	–	–	–	–	225.00	$4 11	3.81
Dec. 4 to Dec. 23, .	109.50	5.76	–	57.00	57.00	57.00	–	327.00	–	–	–	–	2 99	2.73
Dec. 26 to Jan. 13, .	87.84	4.88	–	54.00	54.00	54.00	–	–	239.00	–	–	–	2 65	3.02
Jan. 17 to Feb. 23, .	167.25	4.52	–	111.00	111.00	111.00	185.00	–	–	–	1,603.00	–	7 61	4.55

Cora.

Nov. 8 to Nov. 23, .	128.70	8.58	45.00	45.00	45.00	–	176.00	–	–	–	–	225.00	$3 63	2.82
Dec. 4 to Dec. 23, .	138.50	7.29	–	57.00	57.00	57.00	–	234.00	–	–	–	–	2 76	1.99
Dec. 26 to Jan. 13, .	120.25	6.68	–	54.00	54.00	54.00	–	–	176.00	–	–	–	2 49	2.07
Jan. 17 to Feb. 23, .	228.29	6.17	–	111.00	111.00	111.00	185.00	–	–	–	986.00	–	6 84	2.99
Feb. 27 to Mar. 23, .	134.75	5.39	–	75.00	75.00	75.00	125.00	–	–	864.00	–	–	4 87	3.61

TOTAL COST OF FEED PER QUART OF MILK — *Concluded.*

Lucy.

FEEDING PERIODS.	Total Quantity of Milk produced (Quarts).	Average Daily Yield of Milk (Quarts).	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Maize Feed consumed (Pounds).	Total Amount of Cotton-seed Meal consumed (Pounds).	Total Amount of Hay consumed (Pounds).	Total Amount of Sweet Corn Stover consumed (Pounds).	Total Amount of Dent Corn Stover consumed (Pounds).	Total Amount of Sweet Corn Ensilage consumed (Pounds).	Total Amount of Dent Corn Ensilage consumed (Pounds).	Total Amount of Beets consumed (Pounds).	Total Cost of Feed consumed.	Average Cost of Feed to Production of One Quart of Milk (Cents).
1891-92.														
Nov. 8 to Nov. 23, .	145.35	9.69	45.00	45.00	45.00	–	230.00	–	–	–	–	225.00	$4 05	2.78
Dec. 4 to Dec. 23, .	152.00	8.00	–	57.00	57.00	57.00	–	256.00	–	–	–	–	2 81	1.85
Dec. 26 to Jan. 13, .	133.74	7.43	–	54.00	54.00	54.00	–	–	236.00	–	–	–	2 64	1.98
Jan. 17 to Feb. 23, .	286.00	7.73	–	111.00	111.00	111.00	185.00	–	–	–	876.00	–	6 71	2.35
Feb. 27 to Mar. 23, .	194.75	7.79	–	75.00	75.00	75.00	125.00	–	–	930.00	–	–	4 95	2.54
Gem.														
Dec. 10 to Dec. 23, .	174.98	13.46	–	39.00	39.00	39.00	–	200.07	–	–	–	–	$1 98	1.13
Dec. 26 to Jan. 13, .	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Jan. 17 to Feb. 23, .	487.66	13.18	–	111.00	111.00	111.00	185.00	–	–	–	1,270.95	–	7 20	1.48
Feb. 27 to Mar. 23, .	307.75	12.31	–	75.00	75.00	75.00	125.00	–	–	1,335.00	–	–	5 46	1.77

2. SUMMER FEEDING EXPERIMENTS WITH MILCH COWS.

May, 1892, to September, 1892.

[Green feed: rye, Canada peas and oats, summer vetch and oats, fodder corn and serradella; grain feed: wheat bran, Buffalo gluten feed and cotton-seed meal.]

The experiment was instituted for the same purpose as our summer feeding experiments with milch cows in preceding years (since 1887). The main object of these experiments was to ascertain the fitness of a series of more or less reputed annual fodder crops to serve as the main coarse fodder supply for dairy cows during the growing season (June to October). Their selection as well as their mode of cultivation was largely governed by their special adaptation to the soil and to the period of season when needed to serve as green fodder.

The results obtained in previous years with vetch and oats, soja bean, Southern cow-pea and serradella have been already published. A larger number of different kinds of annual fodder crops have been cultivated during the past season than in preceding ones.

The whole season was divided into four feeding periods, as far as the green coarse fodder articles are concerned, namely, rye, peas and oats, vetch and oats, and fodder corn and serradella. The feeding of the rye and of the oats began when heading out; that of the peas, vetch and serradella when fairly in bloom; while that of the fodder corn began when the kernels commenced glazing.

One-fourth of a daily ration of rowen (second cut of upland meadows), five pounds, was fed in every instance, in common with the temporary green fodder ration.

The amount of rowen and of grain feed fed per day remained the same throughout the entire season. The daily consumption of the green fodder was governed by the individual appetite of the animal, and usually decreased with the advancing growth of the fodder plant.

The feeding of the green crops ceased as soon as they neared maturing. The part of the fodder crops which was left unconsumed was cut and either turned into hay or placed in silos (see farther on for details under field experiments).

The grain feed ration remained the same throughout the entire season, Buffalo gluten feed, wheat bran and cotton-seed meal, three pounds of each daily per animal.

The cows used were, as has been the case in all our previous observations, grades of various descriptions and of a similar general character as on those occasions.

History of Cows.

NAME OF COW.	BREED.	Age (Years).	LAST CALF DROPPED.	Daily Yield of Milk at Beginning of Trial (Quarts).	Number of Months on Trial.
May, .	Native, . .	*	Jan. 15, 1892, .	11.71	6
Gem, .	Grade Shorthorn,	5	Dec. 6, 1891, .	13.53	6
Lucy, .	Grade Ayrshire,	7	June 2, 1891, .	10.88	6
Viola, .	Native, . .	*	Feb. 10, 1892, .	13.09	6
Anna, .	Native, . .	*	Jan. 26, 1892, .	11.94	6
Florence, .	Grade Shorthorn,	*	May 13, 1892, .	11.78	3½

The general management of this feeding experiment was the same as on preceding occasions.

Local Market Cost per Ton of the Various Articles of Fodder used.

Wheat bran, ...	$20 00
Gluten feed (Buffalo), ...	23 00
Cotton-seed meal, ...	28 00
Rowen, ...	15 00
Sugar beets, ...	5 00
Green rye, ...	2 50
Canada peas and oats (green), ...	2 75
Vetch and oats (green), ...	2 75
Corn fodder (green), ...	2 50
Serradella, ...	2 75

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* Unknown.

Analyses of Fine Feed used.

[Grain Feed.]

FOOD ANALYSES.	Wheat Bran.	Gluten Feed.	Cotton-seed Meal.
Moisture at 100° C.,	10.01	6.33	7.05
Dry matter,	89.99	93.67	92.95
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	6.58	0.95	5.40
" cellulose,	11.77	5.76	6.15
" fat,	5.04	12.99	13.82
" protein,	18.06	25.75	38.79
Non-nitrogenous extract matter,	58.55	54.55	35.84
	100.00	100.00	100.00

Fertilizing Constituents.

[Nitrogen 15 cents, phosphoric acid 5½ cents, potassium oxide 4½ cents, per pound.]

FERTILIZER ANALYSES.	Wheat Bran.	Gluten Feed.	Cotton-seed Meal.
Moisture,	10.01	6.33	7.05
Nitrogen,	2.60	3.86	5.77
Phosphoric acid,	2.85	0.207	2.33
Potassium oxide,	1.63	0.04	1.72
Valuation per 2,000 pounds,	$12 40	$11 85	$21 42

Analyses of Coarse Fodder Articles used.

FOOD ANALYSES.	Rowen.	Sugar Beets.	Green Rye.	Canada Peas and Oats.	Vetch and Oats.	Corn Fodder.	Serradella.
Moisture at 100° C., .	13.90	85.27	62.11	86.32	82.02	68.53	82.03
Dry matter, . .	86.10	14.73	37.89	13.68	17.98	31.47	17.97
	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Analysis of Dry Matter.							
Crude ash, . . .	8.28	5.95	5.27	6.90	9.31	5.68	9.59
" cellulose,. .	28.88	6.49	21.52	26.66	29.80	22.99	26.28
" fat, . . .	3.91	0.66	2.46	2.29	2.79	2.81	2.59
" protein, . .	13.45	10.97	5.38	16.01	16.77	6.22	15.13
Non-nitrogenous extract matter, . .	45.48	75.93	65.37	48.14	41.33	62.30	46.41
	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Fertilizing Constituents.

[Nitrogen 15 cents, phosphoric acid 5½ cents, potassium oxide 4½ cents, per pound.]

FERTILIZER ANALYSES.	Rowen.	Sugar Beets.	Green Rye.	Canada Peas and Oats.	Vetch and Oats.	Corn Fodder.	Serradella.
Moisture, . . .	13.90	85.27	62.11	86.32	82.02	68.53	82.03
Nitrogen, . . .	1.853	0.26	0.327	0.350	0.482	0.310	0.435
Phosphoric acid, .	0.464	0.10	0.150	0.130	0.132	0.055	0.126
Potassium oxide, .	1.966	0.48	0.734	0.415	0.418	0.149	0.379
Valuation per 2,000 pounds, . . .	$7 84	$1 32	$1 80	$1 56	$1 97	$1 12	$1 78

Average Composition of the Daily Fodder Rations used during the Five Successive Feeding Periods (1892).

I.		II.	
April 1 to May 21.		*May 27 to June 13.*	
Wheat bran (pounds),	3.00	Wheat bran (pounds),	3.00
Gluten feed (Buffalo),	3.00	Gluten feed (Buffalo),	3.00
Cotton-seed meal,	3.00	Cotton-seed meal,	3.00
Rowen,	5.00	Rowen,	5.00
Sugar beets,	15.00	Green rye,	16.22
Nutritive ratio,	1:4.48	Nutritive ratio,	1:4.82
Total cost (cents),	25.66	Total cost (cents),	16.43
Manurial value obtainable,	10.95	Manurial value obtainable,	8.21
Net cost,	14.71	Net cost,	8.22

III.		IV.	
June 18 to June 28.		*July 4 to August 3.*	
Wheat bran (pounds),	3.00	Wheat bran (pounds),	3.00
Gluten feed (Buffalo),	3.00	Gluten feed (Buffalo),	3.00
Cotton-seed meal,	3.00	Cotton-seed meal,	3.00
Rowen,	5.00	Rowen,	5.00
Canada peas and oats,	27.50	Vetch and oats,	37.71
Nutritive ratio,	1:3.78	Nutritive ratio,	1:3.75
Total cost (cents),	18.16	Total cost (cents),	19.57
Manurial value obtainable,	8.75	Manurial value obtainable,	10.02
Net cost,	9.41	Net cost,	9.55

V.	
September 17 to September 27.	
Wheat bran (pounds),	3.00
Gluten feed (Buffalo),	3.00
Cotton-seed meal,	3.00
Rowen,	5.00
Corn fodder,	30.00
Serradella,	20.00
Nutritive ratio,	1:5.52
Total cost (cents),	20.90
Manurial value obtainable,	9.81
Net cost,	11.09

Summary of Cost of the Above-stated Average Daily Fodder Rations used.

[Cents.]

	Feeding Periods.				
	I.	II.	III.	IV.	V.
Total cost,	25.66	16.43	18.16	19.57	20.90
Manurial value obtainable,	10.95	8.21	8.75	10.02	9.81
Net cost,*	14.71	8.22	9.41	9.55	11.09

* Allowing eighty per cent. of the manurial value of the feed consumed obtainable.

The local market cost of the daily grain feed ration is the same in all stated cases, 11.1 cents; while that of the daily coarse feed ration varies, 5.12 to 14.56 cents (see I. and II. periods). The obtainable manurial value varies from two-fifths to one-half of the total cost of the fodder ration.

Quantity of Milk produced per Day (Quarts).

[One quart equals 2.15 pounds.]

	Feeding Periods.					General Average.	Extreme Variations.
	I.	II.	III.	IV.	V.		
May,	11.71	9.19	9.76	8.54	7.27	9.29	6.05–13.72
Gem,	13.53	11.53	11.34	11.21	11.21	11.76	9.53–16.28
Lucy,	10.88	8.27	9.44	8.98	8.22	9.16	6.74–12.54
Viola,	13.09	9.97	10.22	9.24	7.21	9.95	6.40–14.48
Anna,	11.94	9.19	9.79	8.33	6.94	9.24	6.51–13.14
Florence,	–	–	11.78	11.12	10.56	11.15	9.77–13.95

Cost of Feed per Quart of Milk.

[Cents.]

	Feeding Periods.					General Average.
	I.	II.	III.	IV.	V.	
May,	2.19	1.80	1.86	2.28	2.88	2.20
Gem,	1.89	1.45	1.61	1.75	1.87	1.71
Lucy,	2.36	2.02	1.93	2.19	2.54	2.21
Viola,	1.96	1.62	1.78	2.12	2.90	2.08
Anna,	2.15	1.76	1.86	2.35	3.01	2.02
Florence,	–	–	1.55	1.76	1.98	1.76

Analyses of Milk during Different Feeding Periods.

[Per Cent.]

1892.	MAY.		GEM.		LUCY.		VIOLA.		ANNA.		FLORENCE.	
	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.
Period I.: —												
April 19,	13.70	4.34	12.75	3.93	14.28	4.85	13.24	4.10	11.47	2.80	–	–
May 3,	12.96	3.91	12.20	3.61	13.60	4.51	12.50	3.71	10.71	2.73	–	–
May 17,	14.33	4.38	12.84	3.81	14.44	4.51	14.19	4.64	12.30	3.45	–	–
Period II.: —												
June 7,	15.08	4.90	13.30	4.04	14.45	4.82	14.07	4.61	12.67	3.55	12.07	3.34
Period III.: —												
June 28,	14.57	5.25	12.30	4.59	13.66	3.60	14.03	5.23	12.61	3.86	12.36	3.60
Period IV.: —												
July 12,	12.98	3.56	12.80	3.76	13.91	4.58	13.30	4.29	11.45	2.83	12.03	3.51
July 19,	12.55	2.92	12.86	3.75	14.18	4.92	12.69	3.70	11.33	2.42	12.17	3.16
July 29,	13.75	4.54	12.73	3.31	13.86	4.59	13.08	4.03	12.14	3.20	12.74	4.16

No analysis was made of the milk during the fifth feeding period.

Conclusion.

The results of our summer feeding experiments are on the whole very satisfactory, as may be seen from the summary of the yield of milk and of the cost of feed consumed per quart of milk produced. They furnish also an additional illustration of the statement that a well-regulated system of feeding our dairy stock during the summer secures the most satisfactory results, financially and otherwise.

FEEDING RECORD.

May.

FEEDING PERIODS.	Feed consumed (Pounds) per Day: Wheat Bran.	Gluten Feed.	Cotton-seed Meal.	Rowen.	Sugar Beets.	Green Rye.	Canada Peas and Oats.	Vetch and Oats.	Corn Stover.	Serradella.	Total Amount of Dry Matter consumed per Day (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal (Pounds).
1892.															
April 1 to May 21, .	3.00	3.00	3.00	15.00	15.00	–	–	–	–	–	23.43	11.71	2.00	1:4.48	888
May 27 to June 13, .	3.00	3.00	3.00	5.00	–	16.76	–	–	–	–	18.95	9.19	2.06	1:4.82	834
June 18 to June 28, .	3.00	3.00	3.00	5.00	–	–	27.50	–	–	–	16.36	9.76	1.68	1:3.78	845
July 4 to Aug. 3, .	3.00	3.00	3.00	5.00	–	–	–	37.07	–	–	19.27	8.54	2.26	1:3.70	853
Sept. 17 to Sept. 27, .	3.00	3.00	3.00	5.00	–	–	–	–	30.00	20.00	25.63	7.27	3.52	1:5.22	930

Gem.

FEEDING PERIODS.	Wheat Bran.	Gluten Feed.	Cotton-seed Meal.	Rowen.	Sugar Beets.	Green Rye.	Canada Peas and Oats.	Vetch and Oats.	Corn Stover.	Serradella.	Total Amount of Dry Matter consumed per Day (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal (Pounds).
April 1 to May 21, .	3.00	3.00	3.00	15.00	15.00	–	–	–	–	–	23.43	13.53	1.73	1:4.48	829
May 27 to June 13, .	3.00	3.00	3.00	5.00	–	18.23	–	–	–	–	19.51	11.53	1.69	1:4.83	865
June 18 to June 28, .	3.00	3.00	3.00	5.00	–	–	27.50	–	–	–	16.36	11.34	1.44	1:3.78	847
July 4 to Aug. 3, .	3.00	3.00	3.00	5.00	–	–	–	38.00	–	–	19.43	11.21	1.64	1:3.76	859
Sept. 17 to Sept. 27, .	3.00	3.00	3.00	5.00	–	–	–	–	30.00	20.00	25.63	11.21	2.28	1:5.22	900

FEEDING RECORD — *Concluded.*

Lucy.

FEEDING PERIODS.	FEED CONSUMED (POUNDS) PER DAY.										Total Amount of Dry Matter consumed per Day (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal (Pounds).
	Wheat Bran.	Gluten Feed.	Cotton-seed Meal.	Rowen.	Sugar Beets.	Green Rye.	Canada Peas and Oats.	Vetch and Oats.	Corn Fodder.	Serradella.					
1892.															
April 1 to May 21, .	3.00	3.00	3.00	15.00	15.00	–	–	–	–	–	23.43	10.88	2.15	1:4.48	817
May 27 to June 13, .	3.00	3.00	3.00	5.00	–	18.23	–	–	–	–	19.51	8.27	2.36	1:4.83	821
June 18 to June 28, .	3.00	3.00	3.00	5.00	–	–	27.50	–	–	–	16.36	9.44	1.73	1:3.78	795
July 4 to Aug. 3, .	3.00	3.00	3.00	5.00	–	–	–	38.00	–	–	19.43	8.98	2.16	1:3.76	821
Sept. 17 to Sept. 27, .	3.00	3.00	3.00	5.00	–	–	–	–	30.00	20.00	25.63	8.22	3 12	1:5.22	840

Viola.

FEEDING PERIODS.	Wheat Bran.	Gluten Feed.	Cotton-seed Meal.	Rowen.	Sugar Beets.	Green Rye.	Canada Peas and Oats.	Vetch and Oats.	Corn Fodder.	Serradella.	Total Amount of Dry Matter consumed per Day (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal (Pounds).
April 1 to May 21, .	3.00	3.00	3.00	15.00	15.00	–	–	–	–	–	23.43	13.09	1.78	1:4.48	916
May 27 to June 13, .	3.00	3.00	3.00	5.00	–	13.94	–	–	–	–	17.88	9.97	1.79	1:4.80	875
June 18 to June 28, .	3.00	3.00	3.00	5.00	–	–	27.50	–	–	–	16.36	10.22	1.60	1:3.78	875
July 4 to Aug. 3, .	3.00	3.00	3.00	5.00	–	–	–	38.00	–	–	19.43	9.24	2.10	1:3.76	886
Sept. 17 to Sept. 27, .	3.00	3.00	3.00	5.00	–	–	–	–	30.00	20.00	25.63	7.21	3.55	1:5.22	925

Anna.

April 1 to May 21, .	3.00	3.00	3.00	15.00	15.00	–	–	–	–	–	23.43	11.94	1.97	1:4.48	969
May 27 to June 23, .	3.00	3.00	3.00	5.00	–	13.94	–	–	–	–	17.88	9.19	1.94	1:4.80	935
June 18 to June 28, .	3.00	3.00	3.00	5.00	–	–	27.50	–	–	–	16.36	9.79	1.67	1:3.78	945
July 4 to Aug. 3, .	3.00	3.00	3.00	5.00	–	–	–	37.60	–	–	19.36	8.33	2.08	1:3.75	947
Sept. 17 to Sept. 27, .	3.00	3.00	3.00	5.00	–	–	–	–	30.00	20.00	25.63	6.94	3.70	1:5.22	987

Florence.

June 18 to June 28, .	3.00	3.00	3.00	5.00	–	–	27.50	–	–	–	16.36	11.78	1.39	1:3.78	881
July 4 to Aug. 3, .	3.00	3.00	3.00	5.00	–	–	–	37.60	–	–	19.36	11.12	1.74	1:3.75	938
Sept. 17 to Sept. 27, .	3.00	3.00	3.00	5.00	–	–	–	–	30.00	20.00	25.63	10.56	2.43	1:5.22	935

TOTAL COST OF FEED PER QUART OF MILK.

May.

FEEDING PERIODS.	Total Quantity of Milk produced (Quarts).	Average Daily Yield of Milk (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Feed consumed (Pounds).	Total Amount of Cotton-seed Meal consumed (Pounds).	Total Amount of Rowen consumed (Pounds).	Total Amount of Sugar Beets consumed (Pounds).	Total Amount of Green Rye consumed (Pounds).	Total Amount of Canada Peas and Oats consumed (Pounds).	Total Amount of Vetch and Oats consumed (Pounds).	Total Amount of Corn Fodder consumed (Pounds).	Total Amount of Serradella consumed (Pounds).	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk (Cents).
1892.														
April 1 to May 21,	585.47	11.71	150.00	150.00	150.00	750.00	750.00	–	–	–	–	–	$12 83	2.19
May 27 to June 13,	156.16	9.19	51.00	51.00	51.00	85.00	–	285.00	–	–	–	–	2 81	1.80
June 18 to June 28,	97.56	9.76	30.00	30.00	30.00	50.00	–	–	275.00	–	–	–	1 82	1.86
July 4 to Aug. 3,	256.05	8.54	90.00	90.00	90.00	150.00	–	–	–	1112.00	–	–	5 84	2.28
Sept. 17 to Sept. 27,	72.67	7.27	30.00	30.00	30.00	50.00	–	–	–	–	300.00	200.00	2 09	2.88

Gem.

April 1 to May 21,	676.28	13.53	150.00	150.00	150.00	750.00	750.00	–	–	–	–	–	$12 83	1.89
May 27 to June 13,	196.05	11.53	51.00	51.00	51.00	85.00	–	310.00	–	–	–	–	2 84	1.45
June 18 to June 28,	113.37	11.34	30.00	30.00	30.00	50.00	–	–	275.00	–	–	–	1 82	1.61
July 4 to Aug. 3,	336.16	11.21	90.00	90.00	90.00	150.00	–	–	–	1140.00	–	–	5 88	1.75
Sept. 17 to Sept. 27,	112.09	11.21	30.00	30.00	30.00	50.00	–	–	–	–	300.00	200.00	2 09	1.87

Lucy.

April 1 to May 21,	543.95	10.88	150.00	150.00	150.00	750.00	750.00	-	-	-	-	-	$12 83	2.36
May 21 to June 13,	140.58	8.27	51.00	51.00	51.00	85.00	-	310.00	-	-	-	-	2 84	2.02
June 18 to June 28,	94.42	9.44	30.00	30.00	30.00	50.00	-	-	275.00	-	-	-	1 82	1.93
July 4 to Aug. 3,	269.30	8.98	90.00	90.00	90.00	150.00	-	-	-	1140.00	-	-	5 88	2.19
Sept. 17 to Sept. 27,	82.21	8.22	30.00	30.00	30.00	50.00	-	-	-	-	300.00	200.00	2 09	2.54

Viola.

April 1 to May 21,	654.65	13.09	150.00	150.00	150.00	750.00	750.00	-	-	-	-	-	$12 83	1.96
May 27 to June 13,	169.42	9.97	51.00	51.00	51.00	85.00	-	237.00	-	-	-	-	2 75	1.62
June 18 to June 28,	102.21	10.22	30.00	30.00	30.00	50.00	-	-	275.00	-	-	-	1 82	1.78
July 4 to Aug. 3,	277.21	9.24	90.00	90.00	90.00	150.00	-	-	-	1140.00	-	-	5 88	2.12
Sept. 17 to Sept. 27,	72.09	7.21	30.00	30.00	30.00	50.00	-	-	-	-	300.00	200.00	2 09	2.90

Anna.

April 1 to May 21,	597.09	11.94	150.00	150.00	150.00	750.00	750.00	-	-	-	-	-	$12 83	2.15
May 27 to June 13,	156.28	9.19	51.00	51.00	51.00	85.00	-	237.00	-	-	-	-	2 75	1.76
June 18 to June 28,	97.90	9.79	30.00	30.00	30.00	50.00	-	-	275.00	-	-	-	1 82	1.86
July 4 to Aug. 3,	249.88	8.33	90.00	90.00	90.00	150.00	-	-	-	1128.00	-	-	5 87	2.35
Sept. 17 to Sept. 27,	69.42	6.94	30.00	30.00	30.00	50.00	-	-	-	-	300.00	200.00	2 09	3.01

Florence.

June 18 to June 28,	117.79	11.78	30.00	30.00	30.00	50.00	-	-	275.00	-	-	-	$1 82	1.55
July 4 to Aug. 3,	333.60	11.12	90.00	90.00	90.00	150.00	-	-	-	1128.00	-	-	5 87	1.76
Sept. 17 to Sept. 27,	105.58	10.56	30.00	30.00	30.00	50.00	-	-	-	-	300.00	200.00	2 09	1.98

3. CREAMERY RECORD OF THE STATION FOR 1891 AND 1892.

The cost of feed consumed is based on the market price as stated in the subsequent table. The valuation of the whole milk is taken at three cents per quart. The estimates of the value of fertilizing ingredients contained in the feed are based on those given in the following table: —

Local Market Cost per Ton of the Various Articles of Fodder used.

Corn meal,	$29 50
Wheat bran (in 1891, $24),	20 00
Gluten meal,	27 50
Gluten feed,	23 00
Maize feed,	25 00
Old-process linseed meal,	26 00
Cotton-seed meal,	28 00
Brewers' grain,	23 00
Hay,	15 00
Rowen,	15 00
Green fodder corn,	2 50
Corn stover,	5 00
Corn ensilage,	2 50
Corn and soja bean ensilage,	3 50
Green rye,	2 50
Soja bean (green),	4 40
Canada peas and oats (green),	2 75
Vetch (green),	2 75
Vetch and oats (green),	2 75
Rape,	2 50
Serradella,	2 75
Sugar beets,	5 00
Cabbages,	2 50

Fertilizing Constituents.

[Nitrogen 15 cents, phosphoric acid 5½ cents, potassium oxide 4½ cents, per pound.]

	Nitrogen.	Phosphoric Acid.	Potassium Oxide.	Valuation per 2,000 Pounds.
Corn meal,	1.79	0.71	0.44	$6 55
Wheat bran,	2.60	2.85	1.63	12 40
Gluten meal,	5.22	0.40	0.05	16 15
Gluten feed,	3.86	2.07	0.04	13 89
Maize feed,	4.03	0.70	0.43	13 25
Old-process linseed meal,	5.33	1.64	1.16	18 84
Cotton-seed meal,	5.77	2.33	1.72	21 42
Brewers' grain,	3.299	1.192	1.466	12 53
Hay,	1.38	0.36	1.57	5 95
Rowen,	1.853	0.464	1.966	7 84
Green fodder corn,	0.31	0.055	0.149	1 12
Corn stover,	0.78	0.245	1.20	3 70
Corn ensilage,	0.235	0.113	0.37	1 16
Corn and soja bean ensilage,	0.708	0.42	0.444	2 99
Green rye,	0.327	0.15	0.734	1 80
Soja beans (green),	0.59	0.193	0.311	2 26
Canada peas and oats (green),	0.35	0.128	0.402	1 55
Vetch (green),	0.49	0.133	0.425	2 00
Vetch and oats (green),	0.482	0.132	0.418	1 97
Rape,	0.46	0.12	0.35	1 82
Serradella,	0.435	0.126	0.379	1 78
Sugar beets,	0.26	0.10	0.48	1 32
Cabbages,	0.30	0.11	0.43	1 41

The value of cream is that granted us from month to month by our local creamery association. The station has no other connection with the financial management of the creamery.

Our presentation of financial results is based on the local cost of feed alone, and does not consider interest on investment and labor involved, for the reason that approximate estimates on these points are in an exceptional degree dependent on quality of stock and varying local circumstances. The details are embodied in a few subsequent tables under the following headings: —

1. Statement of articles of fodder used.
2. Record of average quality of milk and fodder rations.
3. Value of cream at creamery basis of valuation.
4. Cost of skim-milk at the selling price of three cents per quart of whole milk.
5. Fertilizing constituents of cream.
6. Some conclusions suggested by the records.
7. Analyses of cream.
8. Average milk analyses for previous years.

1. *Statement of Articles of Fodder used during 1891 (Pounds).*

1891.	Corn Meal.	Wheat Bran.	Gluten Meal.	Maize Feed.	Old-process Linseed Meal.	Cotton-seed Meal.	Brewers' Grain.	Hay.	Rowen.	Green Fodder Corn.	Corn Stover.	Mixed Ensilage.	Vetch and Oats.	Soja Beans.	Sugar Beets.	Cabbages.
January, ...	541.50	541.50	-	-	244.50	297.00	-	-	2,355.00	-	-	1,614.00	-	-	840.00	-
February, . . .	504.00	504.00	306.00	-	-	198.00	-	-	857.00	-	-	7,566.00	-	-	-	-
March, ...	558.00	558.00	450.00	-	-	108.00	-	-	169.00	-	2,153.50	1,269.00	-	-	-	-
April, ...	537.00	540.00	-	-	-	534.00	-	-	1,915.50	-	106.50	-	-	-	-	-
May, ...	558.00	558.00	450.00	-	-	108.00	-	-	3,295.00	-	-	-	-	-	-	-
June, ...	516.00	540.00	516.00	-	-	-	-	-	2,417.50	-	-	-	-	-	-	-
July, ...	555.00	180.00	555.00	-	-	-	378.00	-	1,052.00	-	-	-	7,285.00	-	-	-
August, ...	558.00	324.00	558.00	-	-	-	234.00	-	1,032.50	-	-	-	479.00	6,965.00	-	1,820.00
September, . . .	540.00	-	540.00	-	-	-	540.00	-	690.00	4,504.50	-	-	-	1,011.00	-	1,800.00
October, ...	558.00	-	222.00	-	-	-	558.00	2,673.00	-	-	-	-	-	-	680.00	1,560.00
November, . . .	546.00	423.00	-	442.00	-	18.00	141.00	2,588.00	-	-	-	-	-	-	2,610.00	-
December, . . .	-	555.00	-	555.00	-	549.00	-	102.00	-	-	2,676.00	-	-	-	-	-

1. *Statement of Articles of Fodder used during 1892 (Pounds).*

1892.	Wheat Bran.	Gluten Feed.	Maize Feed.	Cotton-seed Meal.	Hay.	Rowen.	Green Fodder Corn.	Corn Stover.	Corn Ensilage.	Green Rye.	Canada Peas and Oats.	Vetch.	Vetch and Oats.	Rape.	Serradella.	Sugar Beets.	Cabbages.
January, . .	523.50	-	523.50	523.50	570.00	-	-	714.00	3,768.00	-	-	-	-	-	-	-	-
February, .	516.00	-	516.00	516.00	870.00	-	-	-	6,292.00	-	-	-	-	-	-	-	-
March, . .	549.00	150.00	396.00	549.00	870.00	615.00	-	-	4,604.00	-	-	-	-	-	-	840.00	-
April, . .	450.00	450.00	-	450.00	-	2,250.00	-	-	-	-	-	-	-	-	-	2,250.00	-
May, . . .	465.00	465.00	-	465.00	-	1,855.00	-	-	-	850.00	-	-	-	-	-	1,500.00	-
June, . .	540.00	540.00	-	540.00	-	900.00	-	-	-	1,254.00	2,220.00	-	540.00	-	-	-	-
July, . .	558.00	558.00	-	558.00	-	930.00	-	-	-	-	-	-	6,776.00	-	-	-	-
August, . .	558.00	558.00	-	558.00	-	930.00	6,102.00	-	-	-	-	1,380.00	-	882.00	-	-	2,016.00
September, .	540.00	540.00	-	540.00	-	900.00	7,781.00	-	-	-	-	-	-	297.00	2,130.00	-	-
October, . .	558.00	558.00	-	558.00	-	270.00	1,119.00	-	-	-	-	-	-	162.00	1,008.00	-	180.00

2. *Record of Average Quality of Milk and of Fodder Rations (1891).*

1891.	Average Percentage of Solids in Milk.	Average Percentage of Fat in Milk.	Quarts of Milk required to make One Space of Cream.	Nutritive Ratio of Feed.	Feed consumed (Pounds) per Day.														
					Corn Meal.	Wheat Bran.	Gluten Meal.	Maize Feed.	Old-process Linseed Meal.	Cotton-seed Meal.	Brewers' Grain.	Hay.	Rowen.	Green Fodder Corn.	Corn Stover.	Corn and Soja Bean Ensilage.	Vetch and Oats.	Soja Beans.	Sugar Beets.
January, ...	14.99	5.19	1.54	1:4.83	3.00	3.00	-	-	3.00	-	-	-	18.00	-	-	-	-	-	-
				1:4.17	3.00	3.00	-	-	-	3.00	-	-	5.00	-	-	42.00	-	-	-
February, ...	14.71	5.09	1.76	1:4.17	3.00	3.00	-	-	-	3.00	-	-	5.00	-	-	42.00	-	-	-
				1:4.70	3.00	3.00	3.00	-	-	-	-	-	5.00	-	-	46.00	-	-	-
March, ...	14.82	5.00	1.62	1:6.74	3.00	3.00	3.00	-	-	-	-	-	-	-	14.00	-	-	-	-
April, ...	14.41	5.21	1.53	1:5.66	3.00	3.00	-	-	-	3.00	-	-	-	-	14.00	-	-	-	-
				1:4.49	3.00	3.00	-	-	-	3.00	-	-	18.00	-	-	-	-	-	-
May, ...	13.75	4.39	1.67	1:5.14	3.00	3.00	3.00	-	-	-	-	-	18.00	-	-	-	-	-	-
June, ...	-	-	1.76	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
July, ...	13.41	4.18	1.78	1:6.17	3.00	-	3.00	-	-	-	3.00	-	5.00	-	-	-	47.00	-	-
August, ...	13.42	4.22	1.86	1:5.07	3.00	3.00	3.00	-	-	-	3.00	-	5.00	-	-	-	-	51.00	-
				1:4.76	3.00	-	3.00	-	-	-	-	-	5.00	-	-	-	-	47.00	-
September, ...	13.90	4.15	1.75	1:6.17	3.00	-	3.00	-	-	-	3.00	-	5.00	39.00	-	-	-	-	-
October, ...	14.52	4.63	1.72	1:5.79	3.00	-	3.00	-	-	-	3.00	16.00	-	-	-	-	-	-	-
				1:5.34	3.00	-	-	-	-	3.00	3.00	13.90	-	-	-	-	-	-	15.00
November, ...	-	-	1.76	1:6.65	3.00	3.00	-	3.00	-	-	-	14.35	-	-	-	-	-	-	15.00
December, ...	14.42	4.98	1.70	1:4.61	-	3.00	-	3.00	-	3.00	-	-	-	-	14.56	-	-	-	-
Averages, . . .	14.24	4.70	1.73	1:5.28															

2. *Record of Average Quality of Milk and of Fodder Rations (1892).*

1892.	Average Percentage of Solids in Milk.	Average Percentage of Fat in Milk.	Quarts of Milk required to make One Space of Cream.	Nutritive Ratio of Feed.	FEED CONSUMED (POUNDS) PER DAY.													
					Wheat Bran.	Gluten Feed.	Maize Feed.	Cotton-seed Meal.	Hay.	Rowen.	Green Fodder Corn.	Corn Stover.	Corn Ensilage.	Green Rye.	Canada Peas and Oats.	Vetch and Oats.	Serradella.	Sugar Beets.
January,	13.75	4.55	1.73	1:4.63 -	3.00 3.00	- -	3.00 3.00	3 00 3.00	- 5.00	- -	- -	12.06 -	- 32.00	- -	- -	- -	- -	- -
February,	13.24	4.36	1.70	1:4.64	3.00	-	3.00	3.00	5.00	-	-	-	32.00	-	-	-	-	-
March,	12.98	4.10	1.58	1:4.81	3.00	-	3.00	3.00	5.00	-	-	-	41.39	-	-	-	-	-
April,	13.09	4.01	1.72	1:4.48	3.00	3.00	-	3.00	-	15.00	-	-	-	-	-	-	-	15.00
May,	13.00	3.92	1.77	1:4.80	3.00	3.00	-	3.00	-	15.00	-	-	-	-	-	-	-	15.00
June,	13.43	4.28	2.09	1:3.78 1:3.70	3.00 3.00	3.00 3.00	- -	3.00 3.00	- -	5.00 5.00	- -	- -	- -	16.22 -	- 27.50	- -	- -	- -
July,	12.80	3.73	1.82	1:3.76	3.00	3.00	-	3.00	-	5.00	-	-	-	-	-	37.71	-	-
August,	12.30	3.50	2.08	1:5.00	3.00	3.00	-	3.00	-	5.00	50.00	-	-	-	-	-	-	-
September,	12.55	3.66	1.88	1:5.70 1:4.60	3.00 3.00	3.00 3.00	- -	3.00 3.00	- -	5.00 5.00	70.00 30.00	- -	- -	- -	- -	- -	- 20.00	- -
October,	13.17	3.77	1.85	1:5.22	3.00	3.00	-	3.00	-	-	30.00	-	-	-	-	-	20.00	-
Averages,	13.44	4.42	1.82	1:4.60														

3. Value of Cream at Creamery Basis of Valuation.

	Total Cost of Feed consumed.	Total Value of Fertilizing Constituents of Food consumed.	Value of Fertilizing Constituents lost in Cream.	Net Cost of Feed for Production of Cream.	Value of Cream produced.
1891.					
January,	$42 88	$22 85	$0 60	$20 63	$35 23
February,	40 03	24 02	0 61	16 62	35 49
March,	31 38	16 71	0 69	15 36	42 44
April,	35 25	17 52	0 63	18 36	37 36
May,	47 34	22 98	0 74	25 10	40 82
June,	39 32	18 71	0 68	21 29	32 40
July,	40 50	20 20	0 66	20 96	32 26
August,	48 47	20 17	0 68	28 98	36 26
September,	36 88	16 16	0 68	21 40	41 84
October,	41 39	16 62	0 63	25 40	39 48
November,	46 47	17 83	0 52	29 16	32 12
December,	28 75	18 25	0 51	9 93	31 60
Averages,	$39 89	$19 33	$0 64	$21 10	$36 44
1892.					
January,	$31 07	$17 51	$0 55	$14 11	$34 64
February,	34 38	18 36	0 62	16 64	38 95
March,	38 50	20 95	0 76	18 31	45 04
April,	38 47	21 04	0 65	18 08	36 59
May,	35 23	20 13	0 67	15 77	31 65
June,	31 28	19 44	0 57	12 41	27 50
July,	36 11	22 80	0 58	13 89	28 69
August,	39 94	23 95	0 56	16 57	32 22
September,	38 95	22 93	0 55	16 57	33 72
October,	40 12	22 14	0 57	18 55	34 84
Averages,	$36 42	$20 93	$0 61	$16 09	$33 48

4. *Cost of Skim-milk at the Selling Price of Three Cents per Quart for Whole Milk.*

	Quarts of Milk produced.	Spaces of Cream.	Quarts of Cream (One Quart equals 3.4 Spaces).	Quarts of Skim-milk.	Value of Cream per Space (Cents).	Value of Cream per Quart of Milk (Cents).	Total Value of Cream.	Cost of Skim-milk per Quart (Whole Milk at Three Cents per Quart).	Total Cost of Skim-milk.
1891.								Cents.	
January, .	1,413.5	915.0	269.1	1,144.4	3.85	2.49	$35 23	0.63	$7 18
February, .	1,643.8	934.0	274.7	1,369.1	3.80	2.16	35 49	1.01	13 82
March, . .	1,700.2	1,048.0	308.2	1,392.0	4.05	2.50	42 44	0.62	8 57
April, . .	1,468.1	958.0	281.8	1,186.3	3.90	2.54	37 36	0.56	6 68
May, . .	1,889.7	1,134.0	333.2	1,556.5	3.60	2.16	40 82	1.02	15 87
June, . .	1,841.3	1,045.0	307.4	1,533.9	3.10	1.76	32 40	1.49	22 84
July, . .	1,791.2	1,008.0	296.5	1,494.7	3.20	1.80	32 26	1.44	21 48
August, . .	1,924.0	1,036.0	304.7	1,619.3	3.50	1.88	36 26	1.33	21 46
September, .	1,826.9	1,046.0	307.8	1,519.1	4.00	2.29	41 84	0.85	12 97
October, . .	1,659.9	963.0	283.2	1,376.7	4.10	2.38	39 48	0.75	10 32
November, .	1,424.0	803.0	236.2	1,187.8	4.00	2.24	32 12	0.90	10 60
December, .	1,344.0	790.0	232.4	1,111.6	4.00	2.36	31 60	0.79	8 72
Averages, .	1,660.4	973.3	286.3	1,374.3	3.76	2.21	$36 44	0.95	$13 37
1892.									
January, .	1,460.3	845.0	248.5	1,211.8	4.10	2.38	$34 64	0.75	$9 16
February, .	1,612.4	950.0	279.4	1,333.0	4.10	2.42	38 95	0.71	9 42
March, . .	1,818.0	1,155.0	340.0	1,478.0	3.90	2.45	45 04	0.65	9 50
April, . .	1,704.4	989.0	290.9	1,413.5	3.70	2.14	36 59	1.03	14 54
May, . .	1,806.7	1,021.0	300.0	1,506.7	3.10	1.73	31 65	1.50	22 55
June, . .	1,818.5	873.0	256.8	1,561.7	3.15	1.51	27 50	1.73	27 05
July, . .	1,602.8	883.0	260.0	1,342.8	3.25	1.78	28 69	1.44	19 40
August, . .	1,765.8	848.0	249.4	1,516.4	3.80	1.80	32 22	1.36	20 76
September, .	1,581.4	843.0	248.0	1,333.4	4.00	2.12	33 72	1.03	13 71
October, . .	1,614.7	871.0	256.2	1,358.5	4.00	2.16	34 84	1.00	13 61
Averages, .	1,678.5	927.8	272.9	1,405.6	3.71	2.04	$34 38	1.12	$15 97

5. *Fertilizing Constituents of Cream.*

[Average analysis.]

	Per Cent.
Moisture at 100° C., ...	75.22
Nitrogen (15 cents per pound), ...	0.54
Potassium oxide (4½ cents per pound), ...	0.123
Phosphoric acid (5½ cents per pound), ...	0.168

6. *Conclusions.*

1. The nutritive ratio of the feed varied in 1891 from 1 : 4.17 to 1 : 6.74, with an average of 1 : 5.28; in 1892, from 1 : 3.70 to 1 : 5.70, with an average of 1 : 4.60.

2. The percentage of fat in the milk varied in 1891 from 4.15 to 5.21, with an average of 4.70; in 1892, from 3.50 to 4.55, with an average of 4.42.

3. The percentage of total solids varied in 1891 from 13.41 to 14.99, with an average of 14.24; in 1892, from 12.30 to 13.75, with an average of 13.44.

4. The relation of fat to solids not fat in 1891 was 1 : 2.02, while in 1892 it was 1 : 2.04, proving that the lesser yield of fat in 1892 was not due to the influence of the food but rather to the general inferior character of the cows kept.

5. The total cost of feed for one quart of cream amounted in 1891 to 13.93 cents, and in 1892 to 13.35 cents.

6. The net cost of feed for one quart of cream amounted in 1891 to 7.37 cents, and in 1892 to 5.90 cents.

7. The value received for one space of cream varied in 1891 from 3.1 to 4.1 cents, with an average of 3.75 cents; in 1892, from 3.1 to 4.1 cents, with an average of 3.69 cents; which amounted per quart (average) in 1891 to 12.73 cents, and in 1892 to 12.27 cents.

8. The number of quarts of milk required to produce one space of cream in 1891 was 1.73, and in 1892 1.82; or 5.88 quarts of whole milk to produce one quart of cream in 1891, and 6.18 quarts of whole milk to produce one quart of cream in 1892.

9. The net cost of feed per quart of cream averaged in 1891 7.37 cents, and in 1892 5.90 cents. Received per quart of cream in 1891 12.73 cents, and in 1892 12.27 cents, thereby securing a profit of 5.36 cents per quart in 1891, and 6.37 cents in 1892.

For further details concerning results in preceding years, see eighth annual report, pages 54 to 65, and ninth annual report, pages 76 to 82.

Our average statements for the current year apply in each case to only ten months, due to the fact that the financial settlement is made with our local creamery two months after the cream is furnished.

7. *Analyses of Cream.*

DATE OF SAMPLING.	ANALYSIS OF CREAM.			AVERAGE DAILY FODDER RATIONS.
	Solids.	Fat.	Solids not Fat.	
1892.				
Jan. 5, .	28.37	20.29	7.08	3 pounds wheat bran, 3 pounds maize feed, 3 pounds cotton-seed meal, 12.06 pounds dent corn stover.
Jan. 12, .	25.13	16.29	8.84	
Jan. 19, .	24.93	12.95	7.98	3 pounds wheat bran, 3 pounds maize feed, 3 pounds cotton-seed meal, 5 pounds hay, 32 pounds dent corn ensilage.
Jan. 26, .	25.89	15.94	9.95	
Feb. 2, .	27.29	19.21	8.08	
Feb. 16, .	25.62	17.21	8.41	
Feb. 23, .	24.01	15.71	8.30	
March 1, .	26.06	17.26	8.80	3 pounds wheat bran, 3 pounds maize feed, 3 pounds cotton-seed meal, 5 pounds hay, 41.39 pounds sweet corn ensilage.
March 8, .	27.92	20.04	7.88	
March 22, .	25.19	16.13	9.06	
April 19, .	25.18	17.15	8.03	3 pounds wheat bran, 3 pounds gluten feed, 3 pounds cotton-seed meal, 5 pounds rowen, 15 pounds sugar beets.
May 3, .	26.20	19.01	7.19	
June 7, .	25.61	18.80	6.81	3 pounds wheat bran, 3 pounds gluten feed, 3 pounds cotton-seed meal, 5 pounds rowen, 16.22 pounds green rye.
July 19, .	23.40	16.24	7.16	3 pounds wheat bran, 3 pounds gluten feed, 3 pounds cotton-seed meal, 5 pounds rowen, 37.71 pounds vetch and oats.
Aug. 16, .	23.76	17.91	5.85	3 pounds wheat bran, 3 pounds gluten feed, 3 pounds cotton-seed meal, 5 pounds rowen, 60.8 pounds green fodder.
Aug. 23, .	21.35	14.06	7.29	
Aug. 30, .	23.30	16.75	6.55	
Sept. 6, .	22.90	15.88	8.02	
Oct. 18, .	25.63	16.00	9.63	3 pounds wheat bran, 3 pounds gluten feed, 3 pounds cotton seed meal, 15 pounds hay.
Dec. 3, .	25.28	16.90	8.38	3 pounds wheat bran, 3 pounds gluten feed, 3 pounds cotton-seed meal, 15 pounds hay, 15 pounds sugar beets.
Dec. 23, .	25.55	17.00	8.55	3 pounds wheat bran, 3 pounds gluten feed, 3 pounds cotton-seed meal, 15.96 pounds corn stover.

8. *Average Milk Analyses for Previous Years.*

YEAR.	Number of Cows.	Total Solids.	Fat.	Solids not Fat.	Relation of Fat to Solids not Fat.
1884, ...	4	13.01	3.71	9.30	1 : 2.51
1885, ...	2	13.33	4.02	9.31	1 : 2.33
1886, ...	2	12.91	3.97	8.94	1 : 2.25
1887, ...	8	12.73	3.83	8.90	1 : 2.32
1888, ...	6	13.27	3.68	9.59	1 : 2.61
1889, ...	10	13.91	4.31	9.60	1 : 2.23
1890, ...	7	14.01	4.64	9.37	1 : 2.02
1891, ...	14	14.24	4.70	9.31	1 : 2.02
1892, ...	10	13.42	4.42	9.00	1 : 2.04

The methods for butter and milk analyses can be found in the ninth annual report, pages 84 to 86.

4. ANALYSES OF MILK OF DIFFERENT BREEDS OF COWS BY BABCOCK MODE (MADE BY AN ASSISTANT OF THE STATION AT THE REQUEST OF THE OWNER OF THE COWS AT THEIR FARMS). 1892.

Guernsey.

Number.	Age (Years).	Last Calf dropped.	Pounds of Milk given.			Per Cent. of Butter Fat in Milk.		Pounds of Butter Fat in Day's Milk.	Previous Records.	Daily Ration for Week preceding Test.	Date of Testing (1892).
			P.M.	A.M.	Total.	P.M.	A.M.				
1	7	Aug. 25, 1891,	8.50	7.00	15.56	4.7	5.4	0.78	None kept,	Good pasturage, with 2 quarts of meal, 1 quart of oats, and 4 quarts of bran in addition.	June 13, P.M.; 14, A.M.
2	8	March 23, 1891,	6.00	6.00	12.00	4.0	4.5	0.51	" "		" "
3	9	Sept. 23, 1891,	11.50	8.50	20.00	5.6	5.2	1.09	" "		" "
4	6	Aug. 22, 1891,	4.75	4.00	8.75	6.2	7.1	0.59	" "		" "
5	7	March 21, 1890,	10.25	7.75	18.00	5.6	5.4	0.99	" "		" "
6	7	May 25, 1891,	8.50	6.50	15.00	5.2	5.7	0.81	" "		" "
7	5	May 14, 1892,	14.00	14.50	28.50	4.6	4.9	1.35	" "		" "
8	6	Sept. – 1891,*	5.50	3.75	9.25	6.8	7.0	0 64	" -		" "
9	7	Feb. 21, 1892,	12.50	9.50	22.00	4.4	5.3	1.05	" "		" "
10	9	June 21, 1891,	10.00	8.50	18.50	5.0	5.6	0.98	" "		" "
11	6	May 16, 1890,	8.25	6.00	14.25	5.7	5.4	0.79	" "		" "
12	6	Nov. – 1890,*	7.50	7.00	14.50	6.6	6.9	0.98	" "		" "
13	6	July 25, 1891,	6.50	5.50	12.00	7.0	6.4	0.81	" "		" "
14	6	Aug. 20, 1891,	10.25	8.00	18.25	5.3	6.0	1.02	" "		" "
15	3	Oct. 29, 1891,	11.00	8.25	19.25	5.2	6.8	1.13	" "		" "
16	4	May 20, 1892,	15.00	13.00	28.00	3.7	5.3	1.24	" "	Good pasturage,	June 9, P.M.; 10, P.M.
17	–	May – 1892,	11.25	–	–	3.9	3.6	–	" "	" "	" "
18	–	May – 1892,	16.25	–	–	4.2	4.3	–	" "	" "	" "
19	–	Spring, 1891,	4.25	–	–	5.0	6.6	–	" "	" "	" "
20	–	Feb. – 1892,	7.75	–	–	4.8	4.2	–	" "	" "	June 9, P.M.; 10, A.M.
21	–	April 25, 1892,	14.75	15.00	29.75	5.7	5.0	1.59	" "		

* Abortion at seven months.

ANALYSES OF MILK, ETC. — *Continued.*

Guernsey.

Number.	Age (Years).	Last Calf dropped.	Pounds of Milk given.			Per Cent. of Butter Fat in Milk.		Pounds of Butter Fat in Day's Milk.	Previous Records.		Daily Ration for Week preceding Test.	Date of Testing (1892).
			P.M.	A.M.	Total.	P.M.	A.M.			Pounds.		
22	-	Oct. - 1891,	11.25	11.00	22.25	4.7	5.9	1.28	None kept,		Good pasturage, with 3 quarts of a mixture of equal parts of oats and shorts and on an average 3 quarts of corn meal (some receiving 2 quarts, others 4).	June 9, P.M.; 10, A.M.
23	-	Feb. - 1892,	8.50	8.50	17.00	5.1	7.0	1.03	" "			" "
24	-	June 17, 1891,	4.25	3.50	7.75	9.2	6.2	0.61	" "			" "
25	-	Feb. - 1892,	10.75	10.25	21.00	5.5	4.9	1.09	" "			" "
26	-	April 21, 1892,	11.25	7.25	18.50	5.2	4.5	0.91	" "			" "
27*	-	April 19, 1892,	15.25	15.50	30.75	3.2	4.6	1.21	" "			" "
28	-	Nov. - 1891,	11.75	11.50	23.25	4.0	4.5	0.99	" "			" "
29	-	Spring, 1891,	6.00	5.50	11.50	3.9	4.6	0.74	" "			" "
30	-	April 30, 1892,	12.50	11.50	24.00	4.0	4.7	1.04	" "			" "
31	-	Feb. 12, 1892,	15.06	15.13	30.19	4.65	4.8	1.43	Feb. 21 — June 4,	2,706	Good pasturage, with hay night and morning, and 2½ quarts corn meal and 3 quarts of shorts; No. 31 received 3 quarts of corn meal and 4 quarts of shorts.	June 3, P.M.; 4, A.M.
32	-	Dec. 15, 1891,	11.00	10.25	21.25	5.1	6.1	1.20	Dec. 20 — June 4,	3,791		" "
33	-	Jan. 28, 1892,	11.38	10.50	21.88	4.8	5.1	1.08	Feb. 7 — June 4,	2,619		" "
34	-	Nov. 15, 1891,	12.13	10.75	22.88	5.1	5.9	1.25	Dec. 6 — June 4,	3,625		" "
35	-	Nov. 25, 1891,	7.75	7.06	14.81	6.3	6.6	0.95	Dec. 6 — June 4,	2,792		" "
36	-	Dec. 29, 1891,	14.44	12.31	26.75	5.0	4.8	1.31	Jan. 3 — June 4,	4,184		" "
37	2½	Feb. 13, 1892,	11.50	10.50	22.00	4.2	4.0	0.90	Feb. 15 — May 31,	2,348.25	Good pasturage, and green rye once a day; the old cows received 4 quarts of corn meal and 4 quarts of shorts; the young cows 2 quarts of corn meal and 4 quarts of shorts.	June 10, P.M.; 11, A.M.
38	9	Feb. 15, 1892,	11.00	11.50	22.50	4.9	5.5	1.17	Feb. 17 — May 31,	2,615.75		" "
39	10	April - 1891,	11.25	11.00	22.25	4.0	4.4	0.93	May - - -	716.50		" "
40	2	Feb. 15, 1892,	8.00	8.00	16.00	4.9	5.1	0.80	Feb. 17 — May 31,	1,647		" "
41	6	Jan. 5, 1892,	11.00	12.00	23.00	4.1	5.2	1.08	Jan. 7 — May 31,	3,561.75		" "
42	2	Feb. 1, 1892,	8.75	8.50	17.25	4.1	4.1	0.71	Mar. 1 — May 31,	1,493		" "
43	9	Jan. 21, 1892,	9.00	9.00	18.00	5.4	4.9	0.93	Jan. 23 — May 31,	2,199	Good pasturage, and green rye once a day; the old cows received 4 quarts of corn meal and 4 quarts of shorts; the young cows 2 quarts of corn meal and 4 quarts of shorts.	" "
44	3	Oct. 2, 1891,	8.25	8.25	16.50	4.1	3.8	0.65	Dec. 1 — May 31,	3,204.25		" "
45	6	Jan. 21, 1892,	13.25	12.00	25.25	3.9	4.2	1.02	Jan. 23 — May 31,	3,667		" "
46	10	Feb. 6, 1892,	9.00	8.75	17.75	4.0	4.9	0.79	Feb. 8 — May 31,	2,418.25		" "
47	3	Dec. 14, 1891,	9.00	8.50	17.50	4.1	4.1	0.72	Dec. 16 — May 31,	3,367.50		" "
48	2½	Dec. 2, 1891,	10.50	10.50	21.00	5.2	4.1	0.98	Dec. 4 — May 31,	3,691.50		" "
49	3	Sept. - 1891,	8.50	8.50	17.00	3.8	3.8	0.65	Dec. 1 — May 31,	2,941.75		" "
50	6	Sept. 29, 1891,	11.25	11.00	22.25	5.0	4.6	1.07	Dec. 1 — May 31,	4,008.75		" "
51	6	Nov. 16, 1891,	15.50	16.50	32.00	4.0	4.2	1.31	Dec. 1 — May 31,	5,554.75		" "
52	2	Feb. - 1892,	6.75	7.00	13.75	4.0	5.4	0.65	Mar. 1 — May 31,	1,347		" "
53	3	Aug. 30, 1892,	10.00	10.00	20.00	4.2	3.9	0.82	Dec. 1 — May 31,	3,348.50		" "

54	13	Jan.	4, 1892,	13.75	10.00	23.75	5.2	6.4	1.36	None kept,	Good pasturage,	June 29, A.M. and P.M.
55	12	Jan.	17, 1892,	7.75	6.25	14.00	3.6	4.0	0.53	" "	" "	" "
56	9	May	8, 1892,	15.00	9.00	24.00	4.0	4.85	1.04	" "	" "	" "
57	9	May	27, 1892,	18.50	16.00	34.50	4.6	5.15	1.68	" "	" "	" "
58	5	April	6, 1891,	9.00	7.00	16.00	4.45	4.3	0.70	" "	" "	" "
59	4	Feb.	13, 1891,	7.25	7.00	14.25	5.1	6.4	0.81	" "	" "	" "
60	4	June	5, 1891,	9.00	7.25	16.25	5.0	5.5	0.85	" "	" "	" "
61	4	April	2, 1891,	8.50	8.00	16.50	4.5	5.2	0.80	" "	" "	" "
62	3	June	18, 1892,	13.00	11.00	24.00	4.8	6.2	1.31	" "	" "	" "
63	5	March	3, 1891,	4.50	4.75	9.25	4.9	4.8	0.45	" "	Good pasturage, and No. 70 received 2 quarts of corn meal and 2 quarts of wheat bran in addition.	June 15, P.M.; 16, A.M.
64	5	Feb.	25, 1892,	9.50	8.75	18.25	3.9	4.4	0.76	" "		" "
65	4	April	10, 1892,	9.88	7.62	17.50	4.2	4.0	0.72	" "		" "
66	3	April	– 1891,	6.50	5.00	11.50	4.4	4.2	0.50	" "		" "
67	18	June	10, 1891,	6.00	5.00	11.00	3.8	4.4	0.45	" "		" "
68*	5	April	10, 1892,	6.88	7.00	13.88	3.5	2.8	0.44	" "		" "
69	3	May	1, 1892,	9.25	7.25	16.50	4.8	4.7	0.68	" "		" "
70	6	May	9, 1892,	16.50	12.75	29.25	4.0	3.1	1.06	" "		" "
71	3	July	16, 1892,	10.00	12.00	22.00	3.75	3.50	0.80	" "	Pasturage, with about 20 pounds of green corn fodder and 4 quarts of a mixture consisting of 3 weight parts of corn meal and 2 weight parts of wheat bran in addition.	July 29, P.M.; 30, A.M.
72	3	Sept.	12, 1891,	6.00	7.00	13.00	5.00	5.00	0.65	" "		" "
73	3	Oct.	– 1891,	3.50	3.00	6.50	5.10	5.30	0.34	" "		" "
74	4	July	– 1891,	8.00	7.00	15.00	5.75	5.00	0.81	" "		" "
75	3	Dec.	21, 1891,	7.00	7.00	14.00	4.80	5.00	0.68	" "		" "
76	4	July	5, 1892,†	7.00	8.25	15.25	5.10	4.80	0.75	" "		" "
77	3	Jan.	16, 1892,	8.00	8.00	16.00	4.50	4.40	0.71	" "		" "
78	4½	Oct.	11, 1891,	6.00	6.50	12.50	4.40	3.85	0.51	" "		" "
79	10	March	24, 1892,	12.00	10.00	22.00	4.30	4.20	0.93	" "		" "
80	7	Feb.	8, 1892,	12.25	11.00	23.25	4.60	3.60	0.96	" "		" "
81	4	July	24, 1892,	12.00	10.50	22.50	2.90	3.60	0.72	" "		" "
82	5½	Dec.	10, 1891,	8.00	7.00	15.00	4.80	3.40	0.62	" "		" "
83	6	Oct.	10, 1891,	4.00	4.00	8.00	4.90	4.65	0.38	" "		" "
84	3	June	28, 1892,	10.50	10.75	21.25	5.30	5.80	1.18	Pounds. June 28 — Aug. 1, 409.25	Pasturage, with 6 pounds of a mixture consisting of equal weight parts of corn meal, wheat bran, new-process linseed meal and cotton-seed meal; No. 18 received 12 pounds of the grain mixture.	July 15, P.M.; 16, A.M.
85	3½	Aug.	18, 1891,	10.50	9.50	20.00	5.30	5.20	1.05	Aug. 18, '91 — Aug. 1, 6,438.50		" "
86	5¼	July	6, 1892,	12.75	14.00	26.75	5.00	4.95	1.33	July 6 — Aug. 1, 215		" "
87	4	March	26, 1891,	6.00	7.00	13.00	4.60	6.20	0.71	Mar. 26, '91 — Aug. 1, 7,150		" "
88	6	May	18, 1892,	18.94‡	17.50	36.44	3.90	3.50	1.35	May 18 — Aug. 1, 2,704		July 16, A.M. and P.M.
89	6	May	9, 1892,	9.14	7.52	16.66	4.80	4.60	0.78	– – –	– – –	– –
90	5	March	3, 1891,	2.15	2.15	4.30	7.10	6.80	0.30	– – –	– – –	– –
91	5	Feb.	25, 1892,	3.22	2.69	5.91	5.20	5.20	0.31	– – –	– – –	– –
92	4	April	10, 1892,	8.06	4.84	12.90	6.30	5.70	0.78	– – –	– – –	– –
93	3	May	1, 1892,	4.84	4.30	9.14	4.80	5.20	0.46	– – –	– – –	– –
94	3	April	– 1891,	2.69	2.15	4.84	5.50	6.20	0.28	– – –	– – –	– –

* In heat at time of test. † Carried calf only seven months. ‡ Milked three times a day. This is the sum of the noon and evening milking (8.50 and 13.00 pounds); tested at noon.

ANALYSES OF MILK, ETC. — *Continued.*

Holstein.

Number.	Age (Years).	Last Calf dropped.	Pounds of Milk given.			Per Cent. of Butter Fat in Milk.		Pounds of Butter Fat in Day's Milk.	Previous Records (Milk).	Daily Ration for Week preceding Test.	Date of Testing (1892).
			P.M.	A.M.	Total.	P.M.	A.M.		Pounds.		
1	2½	April 28, 1892,	10.00	10.13	20.13	3.80	3.50	0.73	April 28 — Aug. 1, 1,977	Pasturage, with 6 pounds of a mixture consisting of equal weight parts of corn meal, wheat bran, new-process linseed meal and cotton-seed meal.	July 15, P.M.; 16, A.M.
2	3	Jan. 13, 1892,	9.12	8.88	18.00	2.90	2.50	0.49	Jan. 13 — Aug. 1, 4,849		" "
3	3	Jan. 10, 1892,	9.00	8.88	17.88	3.20	1.80	0.45	Jan. 10 — Aug. 1, 4,520		" "
4	3	Nov. 28, 1891,	8.00	8.88	16.88	3.15	2.80	0.50	Nov. 28, '91 — Aug. 1, 4,442		" "
5	6	Feb. 20, 1892,	16.25	16.38	32.63	4.40	3.50	1.29	Feb. 20 — Aug. 1, 7,274		" "
6	5	Dec. 20, 1891,	14.62	15.38	30.00	2.60	4.40	1.06	Dec. 20, '91 — Aug. 1, 8,123		" "
7	5	Jan. 6, 1892,	19.37	19.38	38.75	2.50	2.10	0.89	Jan. 6 — Aug. 1, 9,177		" "
8	2	April 27, 1892,	10.75	11.25	22.00	3.00	1.80	0.53	April 27 — Aug. 1, 1,819		" "
9	3	June 27, 1891,	6.00	6.63	12.63	3.10	2.80	0.37	June 27, '91 — Aug. 1, 7,379		" "
10	3	June 14, 1891,	7.12	7.38	14.50	3.40	4.00	0.54	June 14, '91 — Aug. 1, 7,394		" "
11	3	Feb. 10, 1892,	9.87	10.13	19.00	2.80	1.85	0.46	- - -		" "
12	3	June 1, 1892,	18.50	21.00	39.50	2.00	2.40	0.87	Feb. 10 — Aug. 1, 1,928		" "
13	3	July 2, 1892,	-	18.75	-	-	3.00	-	July 2 — Aug. 1, 409	Pasturage, with 12 pounds of the above grain mixture.	July 16, A.M. and P.M.
14	7	May 11, 1891,	-	2.00	-	-	2.70	-	May 11, '91 — Aug. 1, 13,688		" "

ANALYSES OF MILK, ETC. — *Concluded.*

Holstein.

Number.	Age (Years).	Last Calf dropped.	Pounds of Milk given.				Per Cent. of Butter Fat in Milk.		Pounds of Butter Fat in Day's Milk.	Previous Records (Milk).	Daily Rations for Week preceding Test.	Date of Testing (1892).
			A.M.	M.	P.M.	Total.	A.M.	P.M.		Pounds.		
15	7	April 27, 1892,	23.75	19.44	15.31	58.50	1.80	3.60	1.68	April 27 — Aug. 1, 4,697	Pasturage, with 12 pounds of a mixture consisting of equal weight parts of corn meal, wheat bran, new-process linseed meal and cotton-seed meal.	July 16, A.M. and P.M.
16	7	June 25, 1892,	19.56	14.94	15.06	49.56	2.00	3.60	1.46	June 25 — Aug. 1, 1,495		" "
17	5	April 13, 1892,	19.25	15.12	16.63	51.00	2.00	3.40	1.46	April 13 — Aug. 1, 5,805		" "
18	7	June 19, 1892,	24.00	16.00	20.00	60.00	2.20	3.90	1.93	June 19 — Aug. 1, 2,235		" "
19	6½	June 1, 1892,	25.00	16.00	23.00	64.00	3.80	2.10	1.77	June 1 — Aug. 1, 3,075		" "
20	9	April 27, 1892,	18.00	12.75	14.50	45.25	2.70	3.40	1.41	April 27 — Aug. 1, 4,082		" "
21	4	June 1, 1892,	18.12	14.69	14.44	47.25	3.00	4.10	1.74	June 1 — Aug. 1, 976		" "

5. DISCUSSION ON FODDER ARTICLES AND FODDER SUPPLIES.

[Home-raised Fodder Articles. — Commercial Feed Stuffs. — 1892.]

The fodder articles used in the preparation and compounding of the daily diet of all kinds and conditions of farm live stock are, as a rule, obtained from two distinctly different sources. They are either raised upon the farm and are used usually without any material change in composition, or they are bought in the general market, and are in that case usually the by-products or waste materials of various other branches of industry, as oil works, flour mills, starch works, glucose factories, breweries, etc.

The home-raised fodder crops furnish in the majority of cases the coarse fodder constituent of the daily diet, while the waste or by-products of other industries furnish the fine or grain feed portion of the daily fodder rations. A rational and economical system of stock feeding has assigned to each of these two groups of feed stuffs its proper position in the daily diet of all kinds of farm live stock, with special reference to their general character, adaptation and composition, as well as to good economy and particular efficiency.

A liberal and economical supply of *both classes* of *fodder articles* is to-day recognized as an indispensable requirement of an economical system of stock feeding. To meet our present market condition of the products of the dairy and of the meat supply with any reasonable prospect of a satisfactory compensation for capital invested and labor spent, calls, if possible, for cheaper and more efficient fodder rations than in the majority of instances are in current use.

The importance of a serious and careful consideration of the present condition of our fodder supplies, from both above-stated sources, forces itself from day to day more, not only upon the attention of every farmer, but of all parties interested in the support of our animal industry.

The controlling influence of the temporary local market cost of some of our most prominent current fodder articles on the cost of the production of milk and meat, has been for years pointed out in our bulletins and annual reports, in connection with a description of numerous feeding experiments with milch cows, growing steers, lambs and pigs. An examination of our previous statements concerning the influence of the particular kind of feed stuffs used in the composition of the daily fodder rations on the *market cost*, as well as on the *net cost*, of the feed consumed in the operation, cannot fail to show some striking instances, proving in a marked degree the previously pointed-out circumstance.

As the fodder for our farm live stock comes from two different sources, of equal importance as far as variety, economy and efficiency are concerned, it seems but proper to consider our chances for the improvement of our fodder supply under two separate headings, namely: —

1. Home-raised fodder articles.
2. Commercial feed stuffs.

1. *Home-raised Fodder Articles.*

On various previous occasions, and in particular in Bulletin No. 36, an attempt was made to show that an increase in the production of cultivated annual fodder crops, aside from Indian corn or maize, will tend to increase in an economical way the general productiveness of our farm lands in case of a mixed system of farm industry. The introduction of a greater variety of reputed fodder crops, in particular of the clover family (*Leguminosæ*), it was stated, would prove with us, as it had proved elsewhere, an efficient means to increase not only in an economical way the general productiveness of our farm lands, but tend to *cheapen the cost of feed* for all kinds of farm live stock. A short abstract from the above-stated bulletin may suffice on this occasion to show the standpoint assumed in the matter: —

> A careful inquiry into the history of agriculture has shown that the original productiveness of farm lands in all civilized countries, even in the most favored localities, has suffered in the course of time a gradual decline. This general decline in the fertility of the soil under cultivation has been ascribed, with much propriety in the majority of instances, mainly to two causes, namely: —
>
> A gradual but serious reduction in the area occupied *by forage crops*, natural *pastures* and *meadows;* and a marked decline in the

annual yield of fodder upon large tracts of lands but ill suited for a permanent cultivation of grasses, — the main reliance of fodder production at the time.

A serious falling off in the annual yield of pastures and meadows was followed usually by a gradual reduction in farm live stock, which in turn caused a falling off in the principal home resource of manurial matter.

This chapter in the history of farm management has repeated itself in most countries. The unsatisfactory results of that system of farming finds still an abundant illustration in the present exhausted condition of a comparatively large area of farm lands in New England.

Careful investigations carried on during the past fifty years for the particular benefit of agriculture have not only been instrumental in recognizing and pointing out the principal causes of an almost universal periodical decline of the original fertility of farm lands, but have also materially assisted by field experiments and otherwise in introducing efficient remedies to arrest the noted decline in the annual yield of our most prominent farm crops.

As a scanty supply of manurial matter, due to a serious falling off of one of the principal fodder crops, grasses, was found to be one of the chief causes of less remunerative crops, and thus indirectly has proved to be the main cause of an increase in the cost of the products of the animal industry of the farm, milk and meat, it is but natural that the remedies devised should include, as one of the foremost recommendations, *a more liberal production of nutritious fodder crops.*

The soundness of this advice is to-day fully demonstrated in the most successful agricultural regions of the world. An intensive system of cultivation has replaced in those localities the extensive one of preceding periods; although the area under cultivation for the production of general farm crops has been reduced, the total value of the products of the farm has increased materially in consequence of a more liberal cultivation of reputed fodder crops. The change has been gradual and the results are highly satisfactory.

Viewing *our own present condition*, we notice that well-paying grass land, good natural meadows and rich and extensive pastures are rather an exception than the rule. The benefits derived from indifferently yielding natural pastures are often more apparent than real; the low cost of the production of the fodder is frequently in a large degree set off by a mere chance distribution of the manure produced.

A continued cultivation of but few crops upon the same land, without a liberal, rational system of manuring, has caused in many instances a one-sided exhaustion of the land under cultivation. This circumstance has frequently been brought about in a marked degree by a close rotation of mixed grasses (meadow growth) and of our next main reliance for fodder, the corn (maize). Both crops require potash and phosphoric acid in similar proportion (4 potassium oxide to 1 phosphoric acid), and both require an exceptional amount of the former.

There is good reason to assume that the low state of productiveness of many of our farms, so often complained of, is largely due to the fact that crops have been raised in succession for years, which, like those mentioned, have consumed one or the other essential article of plant food in an exceptionally large proportion, and thereby have gradually unfitted the soil for their remunerative reproduction, while a liberal supply of other equally important articles of plant food is left inactive behind.

As the amount of *available plant food* contained in the soil represents largely the working capital of the farmer, it cannot be otherwise but that the practice of allowing a part of it to lie idle must reduce the interest on the investment.

Personal local observation upon the lands assigned for the use of the station has furnished abundant illustration of the above-described condition of farm lands. In one instance it was noticed that a piece of old, worn-out grass land, after being turned under and properly prepared, as far as the mechanical condition of the soil was concerned, produced, *without any previous application of manure*, an exceptionally large crop of horse beans and lupine, — two reputed fodder crops.

A similar observation was made during the past season, when lands which for years had been used for the production of English hay and corn were used for the cultivation of Southern cow-pea, serradella and a mixed crop of oats and vetch, to serve as green fodder for milch cows. The field engaged for the production of these crops was not manured, because it was to be prepared for a special field experiment during the following season. An area of this land which, under favorable circumstances, would not produce more than six tons of green grass at the time of blooming, yielded nine to ten tons of green vetch and oats, ten tons of green Southern cow-pea, and from twelve to thirteen tons of green serradella.

The exceptional exhaustion of our lands in potash has also been shown abundantly by detailed description of experiments with fodder corn in previous annual reports.

Our local results during past years tend to confirm the opinion held by successful agriculturists that dry grass lands which are in an exceptional degree inclined to a spontaneous overgrowing by an inferior class of fodder plants and weeds, if at all fit for a more thorough system of cultivation, ought to be turned by the plough and subsequently planted with *some hoed crop*, to kill off the foul growth and to improve the physical and chemical condition of the soil. *Such lands prove in many instances ultimately a far better investment when used for the raising of other fodder crops than grasses.*

The less the variety of crops raised in succession upon the same lands, the more one-sided is usually the exhaustion of the soil, and the sooner, as a rule, will be noticed a decrease in their annual yield. The introduction of a greater variety of fodder plants enables us to meet better the differences in local conditions of climate and of soil, as well as the special wants of different branches of farm industry. In choosing plants for that purpose, it seems advisable to select crops which would advantageously supplement our leading fodder crop (aside from the products of pastures and meadows), the fodder corn and corn stover.

Taking this view of the question, the great and valuable family of leguminous plants, as clovers, vetches, lucerne, serradella, peas, beans, lupines, etc., is in a particular degree well qualified for that purpose. They deserve also a decided recommendation in the interest of a wider range for the introduction of economical systems of rotation of crops, under various conditions of soil and different requirements of markets. Most of these fodder plants have an extensive root system, and for this reason largely draw their plant food from the lower portion of the soil. The amount of stubble and roots they leave behind after the crop has been harvested is exceptionally large, and decidedly improves both the physical and chemical condition of the soil. The lands are subsequently better fitted for the production of shallow growing crops, as grains, etc. Large productions of fodder crops assist in the economical raising of general farm crops; although the area devoted to cultivation is reduced, the total yield of the land is usually more satisfactory.

Believing in the soundness of the above-stated views, it has been for years a special task of our work at the station to investigate upon our farm lands the comparative merits, if any, of a variety of fodder plants new to our locality and of a fair reputation elsewhere, as may have been noticed in our annual report. From among those fodder plants which showed a fair degree of adaptation to our soil and climate we have selected for several years past a few for cultivation on a large scale, to increase our fodder supply during the summer and winter season, either as green fodder or in the form of ensilage and hay.

The new crops thus far selected for that purpose are all annual leguminous plants (clover family), as summer vetch, Scotch tares, soja bean, serradella, horse bean and Southern cow-pea. These crops can claim a higher nutritive value than the grasses, and they yield in the majority of cases a larger return per acre. They are readily and with advantage introduced into most local systems of rotation, they tend to increase materially the nitrogen resource of the soil they are raised on in an economical way, besides improving the physical and chemical conditions of the soil in various directions.

One of the principal aims in the cultivation of fodder crops of every description ought to be an increase of their nitrogen containing organic constituents as far as practicable. This result is of special interest in the dairy industry, for milch cows, among full-grown animals, require an exceptionally nutritious diet to do their best.

No class of farm crops shows in a more marked degree the influence of a liberal use of manure. Both the quantity and quality of these crops are materially improved when raised upon lands in a fair state of fertility. Exhausted lands produce invariably an inferior quality of fodder crops of its kind, as far as the amount of their nitrogen-containing organic constituents is concerned. *A liberal production of nutritious annual fodder crops of the right kind improves our chances of supporting more farm live stock, tends to increase our supply of home-made manure, and ultimately becomes the chief reliance of a remunerative mixed farm industry.*

Our trials on a small scale with new fodder crops during the past year include the following: —

Summer vetch,
Soja bean,
Bokhara clover,
Sanfoin,
Horse bean,
Cow-pea,
Yellow trefoil,
Serradella,
Prickly comfrey,
Flat-pea or *Lathyris sylvestris*,
Kidney vetch,
Blue lupine,
Yellow lupine,
White lupine,
Silver-hull buckwheat,
Japanese buckwheat,
Common buckwheat,
Summer rape,
Winter rape,
Artichoke (Jerusalem),
Sugar beet.

Several of the above-enumerated more or less reputed fodder plants have been for some years past successfully cultivated upon the fields of the station, as may have been noticed from previous communications. Some of them have been raised again during the past season on a becoming scale to increase our fodder supply for milch cows, etc., as green fodder during summer and autumn and as ensilage during winter and spring. A summary of our results may be noticed in the following tabular statement. The estimate in regard to meadow growth is based on the results obtained by us on exceptionally good grass land (two tons of first cut and one ton of second cut hay). The annual average yield of meadows for the entire State does not much exceed one ton of hay.

CROP.	Yield per Acre (Tons).	Dry Matter (Per Cent.).	Dry Matter per Acre (Pounds).	Nitrogen in Dry Matter (Per Cent.).	Nitrogen per Acre (Pounds).
Fodder corn (kernels glazing), . . .	18	31.47	11,329	1.02	116
Serradella, . . .	12	17.97	4,313	2.42	104
Vetch and oats, . .	8.05	17.98	2,894	2.68	78
Soja bean, . . .	11.1	26.80	5,949	1.19	71
Hay, ...	2	87.72	3,509	1.64	58
Rye, ...	7	37.89	4,406	0.85	37
Peas and oats, . . .	5	13.68	1,368	2.63	36
Rowen, ...	1	89.79	1,795	2.00	36
Hungarian (second crop after rye), . . .	2.5	25.69	1,285	1.50	18

Rye, vetch and oats, peas and oats, part of soja bean, of corn and of serradella have been fed as green fodder or as hay, and the remainder of green corn and soja bean, serradella and Hungarian, is on hand in silos as mixed ensilage for winter use.

2. *Commercial Feed Stuffs.*

The name commercial feed stuff or concentrated commercial feed stuffs is usually applied to a class of substances offered for sale in our markets which, in the majority of cases, are the waste or by-products of other branches of industry. Some of these articles, as brans, middlings and oil cakes have been for years quite generally used in the daily diet of all kinds of farm live stock; others, as the gluten meal, gluten feed, corn germ meal, dried brewers' grain, malt sprouts, etc., are but recently more generally offered for a similar purpose.

Their importance as an additional valuable fodder supply for the support of every branch of animal industry on the farm and elsewhere has become from year to year more conspicuous, on account of a marked increase of the supply of well-known articles, as well as of the introduction of many new kinds. Their consumption is apparently daily increasing, and seems to keep step with the supply.

The special value claimed for commercial feed stuffs as an important source of fodder supply rests in the main on their fitness to supplement advantageously our coarse home-raised fodder crop in the interest of a higher feeding effect and of a better economy. A frequently good mechanical condition, as well as an exceptionally valuable chemical composition, adapt many of them in a high degree for that purpose.

As no single farm crop or any part of them has been found to supply economically and efficiently to any considerable extent the particular wants of food of our various kinds of farm live stock to secure the best possible results, it becomes a matter of first importance from a mere financial stand-point to know how to supplement our current farm crops to meet the wants of each kind of animals under various circumstances in a desirable degree. To secure the highest feeding effect of each fodder article raised upon the farm is most desirable in the interest of good economy.

Practical experience in the dairy has thus far abundantly shown that the efficiency of a daily diet does not so much depend on the mere use of more or less of one or the other reputed fodder article as on the presence of suitable fodder articles which contain the *three essential groups of food constituents*, i. e., *organic nitrogenous, non-nitrogenous and mineral constituents of plants*, in a desirable form, and in such relative proportions and quantities as have been recognized to be necessary to meet efficiently the food supply of the dairy cow. Similar relations are known to exist in regard to the diet best adapted in case of all kinds of animals. *An economical system of stock feeding has to select among the suitable fodder articles those which furnish the required quality and proportion of the three recognized* *essential food constituents in a digestible form, at the lowest cost.*

Actual observations in stock feeding fully confirm the correctness of the above statement, that a judicious selection from among the current commercial feed stuffs, for the purpose of serving in connection with one or more of our home-raised fodder plants as a fodder ingredient of the daily diet, does, as a rule, tend not only to improve their food value, but also lowers in the majority of cases the net cost of the feed consumed. For more details regarding the determination of the intrinsic value of fodder rations I have to refer on the present occasion, for obvious reasons, to preceding annual reports.

The majority of commercial feed stuffs occupy in a rational system of stock feeding a similar position to our home-raised fodder crops, as is commonly conceded to the commercial fertilizer, with reference to the barn-yard manure for the production of farm crops; they serve for the preparation of a complete diet under different conditions and for different purposes. The individual merits of each of them become in the same degree better appreciated, as the principles which govern animal nutrition are *more generally* understood, and *find a due recognition* in our modes of compounding the daily diet for different kinds as well as for different conditions of the same kind of animals. *They are as a class to-day considered indispensable for a remunerative management of every branch of animal industry on the farm and elsewhere.*

Many of the commercial feed stuffs contain, aside from a liberal amount of phosphoric acid and potash, an exceptionally large percentage of nitrogen. This circumstance gives them a special claim, independent of their respective food value for animals. A liberal addition of these feed stuffs to the daily diet of any kind of animal imparts to the manurial refuse resulting from their use a corresponding higher commercial and agricultural value as a valuable source of plant food. A judicious and liberal introduction of a quite numerous class of commercial feed stuffs into the daily fodder supply of the animals kept on the farm is for this reason *deservedly* recommended as a safe and economical way to increase the home production of plant food in the interest of an increase in the fertility of the farm lands.

As the financial success of a mixed system of farming in particular depends to a considerable degree on the character, the amount and the cost of production of the manurial refuse secured in connection with the special farm industry carried on at the time, it seems to need no further argument to prove that the relation which exists between the temporary *market cost* of the particular feed stuff under consideration and the *market value* of the manurial elements which it contains deserves a serious consideration when devising an efficient and at the same time an economical diet.

The character and commercial value of the manurial refuse obtainable from any kind of feed stuff, under otherwise corresponding conditions, stands in a direct relation to more or less of the different essential fertilizing constituents — phosphoric acid, potash, and in particular nitrogen — it contains. The commercial value of these three important articles of plant food found frequently in prominent commercial feed stuffs equals in many instances more than one-half of the market cost of the particular fodder ingredient in question.

The subsequent tabular statement may serve as an illustration of these relations between market cost and fertilizing value of some current reputed fodder articles: —

NAME OF FEED STUFF.	Market Cost (per Ton)	Manurial Value (per Ton).
Corn meal,	$24 00	$7 31
Gluten meal (Chicago),	28 00	14 72
Chicago maize feed,	25 00	13 25
Buffalo gluten feed,	23 00	12 57
Cotton-seed meal,	28 00	23 52
Linseed meal (old process),	26 00	19 22
Linseed meal (new process),	27 00	20 37
Wheat middlings,	17 00	9 50
Wheat bran,	17 00	13 23
Dried brewers' grain,	23 00	9 96
English hay (first cut of meadows),	15 00	5 92
Rowen (second cut of meadows),	15 00	7 00
Corn fodder,	7 00	4 55
Corn stover,	5 00	3 75
Corn ensilage,	2 50	1 53
Sugar beets,	5 00	1 21
Mangold roots,	4 00	1 01

The above-stated market cost is subject to periodical changes, and the commercial value of their fertilizing constituents varies more or less with the quality of each kind. This feature does not affect materially the force of the point made.

A due appreciation of the previously pointed out favorable features regarding the peculiar character of a numerous class of commercial feed stuffs has caused a steady increase in their consumption on the farm and elsewhere. *The money invested by farmers for securing commercial feed stuffs as an additional food supply for home consumption exceeds to-day many times the amount spent for commercial fertilizers.*

As no single commercial feed stuff can be expected to meet our present demand for these articles, nor can claim to be the most economical one under varying market conditions, and with due appreciation of the varying character of our home-raised fodder supply, it is but proper that every new addition in suitable kinds should receive a deserved attention, and subsequently an actual trial to ascertain its individual merits.

A considerable number of these feed stuffs has already been tried at this station during past years, in connection with our feeding experiments with milch cows, growing steers, lambs and pigs, as may have been noticed in our periodical reports; others are at present on trial. The articles used on those occasions were as a rule bought in the general market. A still larger number of different kinds have been analyzed by us at the request of farmers and dealers in feed stuffs; the samples were usually sent on for that purpose. In regard to the former, there can be no reasonable doubt about their identity; as far as the latter are concerned, the responsibility of furnishing fair representative samples rests in some instances with the parties asking for the analyses.

The results of our analyses of commercial feed stuffs are embodied in the subsequent tabular statement. The record of the analyses is here purposely confined to the extremes noticed, as far as the percentage of *fat* and *nitrogen-containing* organic matter or crude protein are concerned, to engage a special attention in that direction: —

NAME OF FEED STUFF.	Analyses.	DRY MATTER (PER CENT.).			DRY MATTER CONTAINS					
					PROTEIN (PER CENT.).			FAT (PER CENT.).		
		Maximum.	Minimum.		Maximum.	Minimum.		Maximum.	Minimum.	
*Corn meal,	29	89.95	82.96	-	15.57	9.73	-	5.08	3.10	-
*Gluten meal (Chicago),	22	93.50	68.32	-	39.28	25.94	-	12.05	3.92	-
*Gluten feed (Buffalo),	3	93.19	91.03	-	31.05	26.16	-	18.46	11.73	-
Dick gluten flour,	1	-	-	92.93	-	-	33.89	-	-	17.11
Corn germ meal,	1	-	-	90.65	-	-	28.26	-	-	11.82
*Maize feed (Chicago),	3	91.40	90.25	-	29.40	21.33	-	7.90	6.15	-
Dick gluten feed,	1	-	-	91.01	-	-	8.51	-	-	2.26
Corn screenings,	1	-	-	88.98	-	-	8.29	-	-	4.48
Starch feed,	1	-	-	42.96	-	-	22.41	-	-	10.17
Coon gluten meal,	1	-	-	92.13	-	-	25.03	-	-	10.48
Corn germ feed,	1	-	-	92.45	-	-	10.81	-	-	12.17
Hominy meal,	4	91.89	88.68	-	11.88	6.77	-	12.22	4.89	-
*Wheat kernels,	1	-	-	89.42	-	-	13.35	-	-	1.79
*Wheat bran,	35	92.58	86.30	-	20.54	15.67	-	6.08	2.80	-
*Wheat middlings,	6	90.65	87.57	-	19.21	15.13	-	6.46	3.19	-
*Rye bran,	2	91.82	86.30	-	18.98	16.52	-	3.03	2.07	-
*Rye middlings,	1	-	-	87.46	-	-	13.15	-	-	5.61
*Ground barley,	4	89.09	82.59	-	14.93	10.42	-	2.38	1.69	-
*Spent brewers' grain,	4	93.02	88.00	-	33.16	16.08	-	6.29	1.95	-
Malt sprouts,	1	-	-	84.63	-	-	27.17	-	-	3.85
Oat feed,	1	-	-	90.66	-	-	14.06	-	-	8.23
Buckwheat middlings,	1	-	-	88.49	-	-	25.49	-	-	7.53
*Cotton-seed meal,	19	94.31	88.81	-	51.79	36.54	-	14.72	9.47	-
Cotton hulls,	2	89.83	88.55	-	5.36	4.99	-	4.27	2.36	-
*Linseed cake (old process),	7	92.52	88.50	-	39.97	30.98	-	9.87	6.24	-
*Linseed cake (new process),	5	94.94	88.17	-	41.02	35.30	-	4.08	2.17	-

Articles marked * have been bought in the market, or were raised on the land of the station, and there can be no reasonable doubt about fair sampling. The remainder were sent on with name recorded above.

A careful examination of the preceding partial analyses of current commercial feed stuffs cannot fail to show *the existence of most serious variation in the amount of the two most costly food constituents, in case of the same kind.* The differences noticed in that direction affect in many instances, in a marked degree, the food value of the particular article as well as its comparative money value. Some of these variations may be due to differences in the processes at the time employed in the parent industry. *The fact that the majority of this class of feed stuffs are waste or by-products of other industries renders them in an exceptional degree liable to changes in composition. This feature in their production deserves a most careful consideration, from a financial point of view, on the part of the buyer.*

Commercial feed stuffs are usually bought for their high percentage of either nitrogen-containing organic matter or fat, or both. They are used to enrich the daily diet of various kinds of farm live stock in both directions. This course is generally adopted on account of a well-known deficiency of most of our home-raised coarse fodder articles in regard to both food constituents, in particular of nitrogenous matter. Farmers that do not raise a liberal proportion of clover-like fodder plants are in a particular degree in need of concentrated commercial feed stuffs rich in nitrogenous food constituents, to turn the excess of the non-nitrogenous food constituents which most of our current home-raised coarse fodder articles contain to the best possible account.

The liability of pecuniary losses on the part of the buyer, in consequence of exceptional variations in the percentage of nitrogenous organic matter, crude protein or fat, or of both, is quite frequently greatly aggravated by most unexpected serious fluctuations in the market cost of leading feed stuffs.

As we buy in the majority of cases the concentrated commercial feed stuffs on account of their large proportion of nitrogen-containing food constituents, it becomes of special interest to know at what cost a *given quantity of nitrogen-*

containing food constituents can be bought in the form of different feed stuffs equally well adapted under existing circumstances. A change in the *market cost* of one and the same commercial feed stuff affects the cost of the nitrogen-containing food constituent in particular as its supply is more limited than that of the non-nitrogenous food constituents which our home-raised coarse fodder articles contain as a rule in abundance, and which therefore need not to be secured from outside resources for cash.

The subsequent tabular statement assumes a constant cost of digestible non-nitrogenous food constituents, — sugar, starch, fat, etc., — and shows thereby the variations in the cost of digestible nitrogen-containing food constituents, in case of some prominent concentrated commercial feed stuffs in our local market.

The majority of analyses stated are made of fodder articles which have been used either during the past year in connection with some of our feeding experiments, or have been raised upon the grounds of the station. Some articles sent on by outside parties are added, on account of the special interest they may present to others.

Valuation of Fodder Articles on the Following Basis.

[Digestible cellulose and nitrogen-free extract matter, 1 cent per pound; digestible fat, 2½ cents per pound. The value of digestible protein determined the difference of the sum of both and the market cost of the fodder articles. (Calculation is based on dry matter, 2,000 pounds.)]

	Market Cost.	Protein per Pound (Cents).
Corn meal,	$31 00	6.88
Corn meal,	29 00	5.84
Corn meal,	24 00	3.24
Corn meal,	23 00	2.72
Wheat middlings,	20 00	3.13
Spring wheat bran,	19 00	3.04
Winter wheat bran,	21 00	3.93
Chicago maize feed,	23 00	2.34
Dried brewers' grain,	22 00	3.37
Old-process linseed meal,	26 00	2.20
New-process linseed meal,	27 00	2.68
Chicago gluten meal,	28 00	2.46
Cotton-seed meal,	28 00	2.34
English hay,	12 00	1.36
English hay,	15 00	4.12
Rowen,	12 00	1.21
Rowen,	15 00	3.24
Corn stover,*	5 00	–
Corn ensilage,*	2 50	–
Mangold roots,*	3 00	–
Sugar beets,*	5 00	–

* The value of the digestible cellulose, nitrogen-free extract matter and fat, on the above basis, exceeds the market cost.

Prices are apt to rise and to fall without any reference to the agricultural value of the article in question.

Names may remain the same, and in fact do remain in some instances, while the composition of the article suffers serious changes in consequence of changes in the parent industry.

Sales without due responsibility regarding the particular quality of the goods delivered leaves the pecuniary risk involved in the transaction in an objectionable degree on the side of the buyer.

Unaccounted-for variations in the composition of feed stuffs must prove a serious obstacle in the desirable introduction of a rational and economical system of stock feeding.

For these and other reasons previously pointed out it cannot be claimed that the prevailing mode of selling and buying commercial feed stuffs rests on a just and fairly equitable basis.

The trade in commercial feed stuffs is to-day in a similar unsatisfactory condition as was the trade in commercial fertilizers before the introduction of a system of State inspection in regard to those articles.

The generally conceded success of the introduction of a well-regulated system of State inspection in regard to commercial fertilizers seems to suggest the adoption of a similar course with reference to the trade in commercial feed stuffs.

The best interests of both manufacturers and farmers, in fact of every one who keeps live stock for his accommodation, render such changes desirable in the present mode of selling and buying feed stuffs as will impose mutual and equitable responsibility on all parties interested in the transaction. The limited margins for profit in every branch of animal industry carried on at our farms necessitates a careful attention to all the details of the business. The money interests involved are of an exceptional magnitude.

A due consideration of the present condition of our trade in commercial feed stuffs has induced the Board of Control of the Massachusetts State Agricultural Experiment Station to request the writer to present the subject once more to the consideration of all parties interested; and to invite their co-operation in devising suitable means to secure a fair degree of mutual responsibility on the part of all parties interested in the trade and the consumption of commercial feed stuffs.

C. A. GOESSMANN.

NOVEMBER, 1892.

6. ANALYSES OF FODDER ARTICLES MADE AT THE STATION IN 1892.

Green Corn (1891).

[I., Pride of the North; II., Stowell's Evergreen.]

[From station barn.]

	PER CENT.	
	I.	II.
Moisture at 100° C.,	71.86	83.91
Dry matter,	28.14	16.09
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	3.78	6.73
" cellulose,	25.67	26.03
" fat,	2.24	3.26
" protein,	7.62	8.09
Non-nitrogenous matter,	60.69	55.89
	100.00	100.00

Corn Stover (1891).

[I., Pride of the North; II., Stowell's Evergreen.]

[From station barn.]

	PER CENT.	
	I.	II.
Moisture at 100° C.,	20.10	41.62
Dry matter,	79.90	58.38
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	6.12	9.76
" cellulose,	33.72	37.79
" fat,	2.51	2.44
" protein,	7.75	6.08
Non-nitrogenous matter,	49.90	43.93
	100.00	100.00

Corn Kernels (1891).

[I., Pride of the North; II., Stowell's Evergreen.]

[From station barn.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	13.68	11.98
Dry matter,	86.32	88.02
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	1.29	1.63
“ cellulose,	1.69	2.41
“ fat,	4.11	9.56
“ protein,	10.42	12.57
Non-nitrogenous matter,	82.49	73.83
	100.00	100.00

Corn Cobs (1891).

[I., Pride of the North; II., Stowell's Evergreen.]

[From station barn.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	7.00	5.95
Dry matter,	93.00	94.05
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	1.42	2.53
“ cellulose,	37.84	34.19
“ fat,	0.35	0.77
“ protein,	1.46	1.73
Non-nitrogenous matter,	58.83	58.78
	100.00	100.00

Stowell's Evergreen Sweet Corn (1891).

[From station barn.]

	I.	II.	III.	IV.
Ears (four) : —				
Number of rows, ...	14	14	16	14
Moisture at 100° C., . . .	11.98	11.98	11.98	11.98
Total weight of ear (grams), .	116.3	104.6	111.5	79.3
Weight of kernels (grams), . .	91.87	77.4	90.9	61.0
Per cent. of total weight, . .	78.99	73.99	81.52	76.92
Weight of cobs (grams), . .	24.43	27.2	20.6	18.3
Per cent. of total weight, . .	21.01	26.01	18.48	23.08

Corn Ensilage (1891).

[I., Pride of the North; II., Stowell's Evergreen.]

[From station barn.]

	Per Cent.	
	I.	II.
Moisture at 100° C., ...	79.98	84.30
Dry matter, ...	20.08	15.70
	100.00	100.00
Analysis of Dry Matter.		
Crude ash, ...	4.99	6.32
" cellulose, ...	27.19	29.32
" fat, ...	3.29	7.36
" protein, ...	8.29	7.86
Non-nitrogenous matter, ...	56.24	49.14
	100.00	100.00
Acidity (as acetic acid), ...	1.18	1.33

Fertilizing Constituents.

Moisture, ...	79.98	84.30
Nitrogen, ...	0.266	0.197
Phosphoric acid, ...	–	0.087
Potassium oxide, ...	–	0.406
Valuation per 2,000 pounds, ...	–	$1 05

Vetch and Oats, green (1891).

[From station barn.]

	Per Cent.
Moisture at 100° C.,	57.96
Dry matter,	42.04
	100.00

Analysis of Dry Matter.

Crude ash,	7.97
" cellulose,	30.77
" fat,	2.58
" protein,	8.83
Non-nitrogenous extract matter,	49.85
	100.00

Notes on Changes in Dry Matter during Growth.

	July 7, 1891.	July 22, 1891.	Aug. 3, 1891.
Moisture at 100° C.,	79.75	64.77	57.96
Dry matter,	20.25	35.23	42.04

Soja Bean, green (1891).

[From station barn.]

	Per Cent.
Moisture at 100° C.,	72.22
Dry matter,	27.78
	100.00

Analysis of Dry Matter.

Crude ash,	6.39
" cellulose,	31.49
" fat,	3.39
" protein,	13.71
Non-nitrogenous extract matter,	45.02
	100.00

Notes on Changes in Dry Matter during Growth.

	Aug. 3, 1891.	Aug. 17, 1891.	Sept. 2, 1891
Moisture at 100° C.,	80.24	72.22	70.22
Dry matter,	19.76	27.78	29.78

Green Rye (1892).

[From station barn.]

	Per Cent.
Moisture at 100° C.,	62.11
Dry matter,	37.89
	100.00

Analysis of Dry Matter.

Crude ash,	5.27
" cellulose,	21.52
" fat,	2.46
" protein,	5.38
Non-nitrogenous extract matter,	65.37
	100.00

Fertilizing Constituents.

Moisture,	62.11
Nitrogen,	0.327
Phosphoric acid,	0.15
Potassium oxide,	0.734
Valuation per 2,000 pounds,	$1 80

*Hungarian Grass, green * (1892).*

[From station barn.]

	Per Cent.
Moisture at 100° C.,	74.31
Dry matter,	25.69
	100.00

Analysis of Dry Matter.

Crude ash,	8.94
" cellulose,	31.23
" fat,	2.43
" protein,	9.39
Non-nitrogenous extract matter,	48.01
	100.00

Fertilizing Constituents.

Moisture,	74.31
Nitrogen,	0.385
Phosphoric acid,	0.159
Potassium oxide,	0.549
Valuation per 2,000 pounds,	$1 82

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* Second crop after rye.

Green Corn Fodder (1892).

[From station barn.]

	Per Cent.
Moisture at 100° C.,	68.53
Dry matter,	31.47
	100.00

Analysis of Dry Matter.

Crude ash,	5.68
" cellulose,	22.99
" fat,	2.81
" protein,	6.22
Non-nitrogenous extract matter,	62.30
	100.00

Fertilizing Constituents.

Moisture,	68.53
Nitrogen,	0.31
Phosphoric acid,	0.055
Potassium oxide,	0.149
Valuation per 2,000 pounds,	$1 12

Corn Stover (1892).

[From station barn.]

	Per Cent.
Moisture at 100° C.,	14.66
Dry matter,	85.34
	100.00

Analysis of Dry Matter.

Crude ash,	5.49
" cellulose,	37.57
" fat,	1.82
" protein,	4.00
Non-nitrogenous extract matter,	51.02
	100.00

Fertilizing Constituents

Moisture,	14.66
Nitrogen,	0.546
Phosphoric acid,	0.228
Potassium oxide,	1.84
Valuation per 2,000 pounds,	$3 55

Soja Bean, green (1892).*

[From station barn.]

	Per Cent.
Moisture at 100° C.,	73.20
Dry matter,	26.80
	100.00

Analysis of Dry Matter.

Crude ash,	6.80
" cellulose,	30.54
" fat,	2.29
" protein,	6.82
Non-nitrogenous extract matter,	53.55
	100.00

Fertilizing Constituents.

Moisture,	73.20
Nitrogen,	0.292
Phosphoric acid,	0.151
Potassium oxide,	0.531
Valuation per 2,000 pounds,	$1 52

Soja Bean Straw, Late Variety (1892).

[From station barn.]

	Per Cent.
Moisture at 100° C.,	7.63
Dry matter,	92.37
	100.00

Analysis of Dry Matter.

Crude ash,	10.72
" cellulose,	36.80
" fat,	3.49
" protein,	5.34
Non-nitrogenous extract matter,	43.65
	100.00

Fertilizing Constituents.

Moisture,	7.63
Nitrogen,	0.789
Phosphoric acid,	0.397
Potassium oxide,	1.322
Valuation per 2,000 pounds,	$4 19

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* Late variety.

Cotton-seed Meal.

[I. and II. sent on from Boston, Mass.; III., IV. and V. sent on from Amherst, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	8.62	8.73	8.53	8.83	6.17
Dry matter,	91.38	91.27	91.47	91.17	93.83
	100.00	100.00	100.00	100.00	100.00
Analysis of Dry Matter.					
Crude ash,	6.44	5.94	7.54	4.72	5.34
" cellulose,	6.19	21.05	5.87	9.77	7.68
" fat,	10.69	6.23	11.67	9.47	14.19
" protein,	44.45	26.97	48.23	42.43	44.89
Non-nitrogenous extract matter,	32.23	39.79	26.69	33.61	27.90
	100.00	100.00	100.00	100.00	100.00

Fertilizing Constituents.

Moisture,	8.62	8.73	8.53	8.83	6.17
Nitrogen,	6.50	3.94	7.06	6.19	6.74
Phosphoric acid,	4.51	3.41	3.28	2.07	3.26
Potassium oxide,	1.49	1.398	1.37	1.48	1.70
Valuation per 2,000 pounds,	$25 80	$16 84	$26 02	$22 18	$25 34

Cotton-seed Meal.

[From station barn.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	7.05	5.69	6.81
Dry matter,	92.95	94.31	93.19
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	5.40	7.56	7.10
" cellulose,	6.15	7.76	6.54
" fat,	13.82	12.48	12.69
" protein,	38.79	43.69	44.33
Non-nitrogenous extract matter,	35.84	28.51	29.34
	100.00	100.00	100.00

Buffalo Gluten Feed.

[I. sent on from North Amherst, Mass.; II., III. and IV. from station barn.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	8.82	8.97	6.33	6.82
Dry matter,	91.18	91.03	93.67	93.18
	100.00	100.00	100.00	100.00
Analysis of Dry Matter.				
Crude ash,	1.12	0.77	0.95	0.83
" cellulose,	6.17	5.09	5.76	4.94
" fat,	12.86	13.46	12.99	13.03
" protein,	31.05	26.16	25.75	28.71
Non-nitrogenous extract matter,	48.80	54.52	54.55	52.49
	100.00	100.00	100.00	100.00

Gluten Feed.

[I. sent on from Amherst, Mass.; II. sent on from North Amherst, Mass.,; III. sent on from Chicago, Ill.]

	Per Cent.		
	I.	II.*	III.†
Moisture at 100° C.,	6.81	7.87	13.98
Dry matter,	93.19	92.13	86.02
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	1.81	1.97	0.75
" cellulose,	6.39	1.58	1.80
" fat,	11.73	10.48	16.34
" protein,	28.43	25.03	38.68
Non-nitrogenous extract matter,	51.64	60.94	42.43
	100.00	100.00	100.00

* Coon gluten feed.

† Pope's gluten feed.

Gluten Meal.

[Sent on from Glen Cove, L. I.]

	Per Cent.
Moisture at 100° C.,	8.80
Dry matter,	91.20
	100.00
Analysis of Dry Matter.	
Crude ash,	0.46
" cellulose,	6.10
" fat,	8.49
" protein,	18.18
Non-nitrogenous extract matter,	66.77
	100.00

Dick Gluten Flour.

[Sent on from North Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	7.07
Dry matter,	92.93
	100.00
Analysis of Dry Matter.	
Crude ash,	0.91
" cellulose,	1.69
" fat,	17.11
" protein,	33.89
Non-nitrogenous extract matter,	46.40
	100.00

Corn Meal.

[I. sent on from Sherborn, Mass.; II. from station barn.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	12.38	13.96
Dry matter,	87.62	86.04
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	1.76	1.26
" cellulose,	1.92	1.49
" fat,	4.69	3.97
" protein,	10.83	11.11
Non-nitrogenous extract matter,	80.80	82.17
	100.00	100.00

Corn Meal.

[I., yellow corn meal; II., white corn meal; sent on from Salem, Mass.]

	PER CENT.	
	I.	II.
Moisture at 100° C.,	10.45	7.20
Dry matter,	89.55	92.80
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	0.95	2.47
" cellulose,	2.19	5.01
" fat,	4.62	11.22
" protein,	11.03	11.45
Non-nitrogenous extract matter,	81.21	69.85
	100.00	100.00

Corn Screenings.

[Sent on from Baldwinville, Mass]

	Per Cent.
Moisture at 100° C.,	11.02
Dry matter,	88.98
	100.00
Analysis of Dry Matter.	
Crude ash,	2.39
" cellulose,	3.27
" fat,	4.48
" protein,	8.29
Non-nitrogenous extract matter,	81.57
	100.00

Corn Germ Meal.

[Sent on from Conway, Mass.]

	Per Cent.
Moisture at 100° C.,	7.55
Dry matter,	92.45
	100.00
Analysis of Dry Matter.	
Crude ash,	0.87
" cellulose,	14.05
" fat,	12.17
" protein,	10.81
Non-nitrogenous extract matter,	62.10
	100.00

Maize Feed.

[From station barn.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	8.80	8.60
Dry matter,	91.20	91.40
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	0.65	0.92
" cellulose,	8.01	7.93
" fat,	6.84	7.90
" protein,	25.69	29.40
Non-nitrogenous extract matter,	58.81	53.85
	100.00	100.00

Wheat Bran.

[From station barn.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	10.01	10.18
Dry matter,	89.99	89.82
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	6.58	6.65
" cellulose,	11.77	12.04
" fat,	5.04	4.49
" protein,	18.06	17.05
Non-nitrogenous extract matter,	58.55	59.77
	100.00	100.00

Starch Feed.

[I. sent on from Boston, Mass.; II. sent on from Chicago, Ill.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	7.37	5.48
Dry matter,	92.63	94.52
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	0.62	0.90
" cellulose,	5.84	15.21
" fat,	12.35	11.30
" protein,	35.61	11.28
Non-nitrogenous extract matter,	45.48	61.31
	100.00	100.00

Oat Feed.

[Sent on from Boston, Mass.]

	Per Cent.
Moisture at 100° C.,	9.34
Dry matter,	90.66
	100.00
Analysis of Dry Matter.	
Crude ash,	4.40
" cellulose,	8.79
" fat,	8.23
" protein,	14.06
Non-nitrogenous extract matter,	66.52
	100.00

Malt Sprouts.

[Sent on from South Acton, Mass.]

	Per Cent.
Moisture at 100° C.,	15.37
Dry matter,	84.63
	100.00
Analysis of Dry Matter.	
Crude ash,	6.31
" cellulose,	14.75
" fat,	3.85
" protein,	27.17
Non-nitrogenous extract matter,	47.92
	100.00

Ground Barley.

[From station barn.]

	Per Cent.
Moisture at 100 C.,	10.91
Dry matter,	89.09
	100.00

Analysis of Dry Matter.

Crude ash,	3.19
" cellulose,	4.10
" fat,	2.13
" protein,	13.33
Non-nitrogenous extract matter,	77.25
	100.00

Chicken Feed (Ground Meat Scraps).

[Sent on from North Hadley, Mass.]

	Per Cent.
Moisture at 100° C.,	3.71
Dry matter,	96.29
	100.00

Analysis of Dry Matter.

Crude ash,	35.61
" cellulose,	–
" fat,	20.31
" protein,	40.08
Non-nitrogenous extract matter,	–

Fertilizing Constituents.

Moisture,	3.71
Nitrogen,	6.51
Phosphoric acid,	2.29
Potassium oxide,	–

II.

FEEDING EXPERIMENTS WITH STEERS (TWO).

1889–92.

Introduction. — The two new feeding experiments briefly described within a few subsequent pages may be considered as a continuation of a preceding one, reported in full in our ninth annual report, 1891–92, pages 107 to 127. They were planned chiefly for the purpose of ascertaining *the cost of the feed for the production of beef for the meat market in case of growing steers, under existing local market conditions of the supply of coarse and fine feed stuffs and of cost of beef.*

During our first experiment in the stated direction, four young steers, grade Shorthorn, two one year old and two two years old, served for our observation. They were selected at different stages of growth, for the *special purpose of observing and comparing the feeding effect of one and the same suitable daily diet on the rate of increase in live weights* and on *the cost of the feed consumed per pound of live weight produced*, under specified conditions.

The *coarse fodder articles used on that occasion* were home raised, and consisted, from the beginning to the end of the trial, of either dry fodder corn, or corn ensilage, or corn stover, all obtained from the same variety of field corn, — Pride of the North. The corn used for the production of dry fodder corn and of corn ensilage was in both cases of a corresponding stage of growth, — kernels glazing. The corn stover was obtained from the fully matured crop.

The *fine* or *grain feed* used in that connection in the preparation of the daily fodder rations consisted, as a rule, of equal weights of either wheat bran and Chicago gluten meal, or of wheat bran and old-process linseed meal, or of wheat bran, old-process linseed meal and corn and cob meal. The total quantity of the grain feed mixture used daily, per head, varied from seven to nine pounds; it never exceeded nine pounds. The amount of coarse feed daily consumed per head was controlled in every case by the appetite of each animal on trial. Both lots of steers were kept in the stall during the entire time occupied by the observation, — December, 1889, to April, 1890.

The most satisfactory results were noticed in case of both lots, as far as the daily increase in live weight is concerned, when corn ensilage was fed with a mixture of either wheat bran and Chicago gluten meal or of wheat bran and old-process linseed meal. During a period of from six to seven weeks, when feeding the stated feed stuffs, the daily gain in live weights in case of the yearlings reached in one instance as high as 2.9 pounds per head, while in case of the two-year-old steers it amounted under corresponding conditions to 3.45 pounds per head. The live weight of the yearlings at that time was from 650 to 700 pounds each, and that of the older steers from 1,150 to 1,200 pounds each. The *market cost* of the daily fodder rations used at the stated time averaged, per head, in case of the yearlings, 13.79 cents, and *its net* cost was 5.03 cents; while in case of the two older steers the market cost of the daily fodder rations averaged 18 cents per head, and its net cost was 7.04 cents. We paid in case of both lots of young steers 3½ cents per pound of live weight, and sold at the close of the experiments the older lot of steers to the butcher at 3¾ cents per pound of live weight. The shrinkage noticed between live weight and dressed weight varied from 34 to 36 per cent. Dressed beef brought at that time from 5¾ to 6 cents per pound.

The financial result of the experiment, as far as the highest daily yield of live weight is concerned, at stated market price, may be seen from the following summary: —

SUMMARY.	Yearlings.	Two-year-olds.
Market cost of daily fodder rations,	13.79 cents.	18.00 cents.
Obtainable manurial value per day,	8.76 "	10.96 "
Net cost of daily fodder rations,*	5.03 "	7.04 "
Live weight produced per day,	2.99 lbs.	3.45 lbs.
Cash received for live weight produced per day,	11.21 cents.	12.97 cents.

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* Allowing ninety-two per cent. of the manurial value of the feed consumed obtainable.

From these statements it will be noticed that the profit secured by the operation consisted in the value of the obtainable manure and in the disposition of our home-raised fodder articles at fair local retail selling prices. The yearlings proved more remunerative than the two-year-old steers.

Two facts were apparently fairly demonstrated by our first observation, namely: —

1. Yearlings increase at a higher rate in live weight, in case of a corresponding suitable diet, than two-year-old steers, taking the total temporary live weight of the animal on trial as the basis for the comparison. The highest daily increase in the live weight of the yearlings — 650 pounds each — amounted in our first feeding experiment to 0.46 pounds per one hundred pounds of live weight; and in that of the two-year-old steers — 1,150 pounds each — to 0.3 pounds per one hundred pounds of live weight.

2. Our local market price of young steers and of dressed beef necessitates not only an exceptional care in the selection of efficient and low-priced feed stuffs, but also a careful attention in regard to a judicious combination of suitable feed stuffs for the preparation of an economical diet, to render with us the production of beef for the meat market remunerative.

To assist in a desirable solution of that problem is the principal motive for continuing our observation in the stated direction.

Some of the leading features in the management of our *first* feeding experiment are retained in the course pursued during our *second* experiment, which is farther on briefly described. The difference between the latter and the first feeding experiment consists in the following circumstances: —

1. One set of young steers — yearlings — served from the beginning to the end of the experiment.

2. The observation extended over a period of sixteen months, including two succeeding winter seasons, with summer pasturing between them.

3. The animals were kept in the stall, practically without any out-door exercise, during the late autumn, the winter and the earlier part of the spring. During the growing season, from May to the middle of October, they were turned

for support into a good pasture; no additional food from any outside source was offered during that period.

4. A greater variety of coarse and fine fodder articles was used in the preparation of the daily diet at different stages of the experiments during the second winter season than on the preceding occasion.

SECOND FEEDING EXPERIMENT WITH STEERS.

December, 1889, to March, 1891.

Two one-year-old steers, grade Shorthorn, of fairly corresponding general condition, served in the trial. They were bought at 3½ cents per pound of live weight. No. 1 weighed 675 pounds, No. 2 weighed 600 pounds, when bought. The systematic feeding began during the middle of December, 1889, both receiving as far as practicable at all times the same daily fodder rations. The mode of feeding was the same as described in the preceding experiment, — twice a day; water was offered two hours after feeding.

The grain-feed part of the daily diet was at all times a definite one, and the same in quantity and quality in case of both animals. The amount of the coarse feed consumed daily was governed by the appetite of each animal. The composition of the daily fodder rations used during the first winter season, 1889–90, differed materially from those used during the second winter season, 1890–91. This circumstance renders it advisable, in the interest of a due appreciation of the feeding results in different stages of the trial, to state our results with reference to its *three distinctly different feeding periods;* namely, feeding record of *first winter season*, of *summer pasturing* and of *second winter season.*

1. *Feeding Record of First Winter Season.*

Dec. 17, 1889, to May 9, 1890.

[Coarse fodder articles: dry fodder corn, corn ensilage, corn stover and sugar beets; fine fodder articles: wheat bran, Chicago gluten meal, old process linseed meal and corn and cob meal.]

Local Market Cost per Ton of the Various Articles of Fodder used.

Wheat bran,	$16 50
Gluten meal, Chicago,	23 00
Old-process linseed meal,	27 50
Corn and cob meal,	16 50
Corn stover,	5 00
Corn ensilage,	2 75
Corn fodder,	7 50
Sugar beets,	5 00

Analyses of the Various Articles of Fodder used.

FOOD ANALYSES.	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	Corn and Cob Meal.	Corn Stover.	Corn Ensilage.	Corn Fodder.	Sugar Beets.
Moisture at 100° C.,	9.27	9.80	9.88	8.10	26.95	72.95	20.42	90.02
Dry matter,	90.73	90.20	90.12	91.90	73.05	27.05	79.58	9.98
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Analysis of Dry Matter.								
Crude ash,	7.47	1.25	7.39	1.47	5.80	6.48	7.40	11.84
" cellulose,	9.75	1.75	8.74	5.63	34.33	26.33	20.11	8.20
" fat,	5.48	7.00	7.24	3.73	1.66	5.17	1.65	0.71
" protein,	17.53	31.25	36.97	9.79	7.90	7.64	8.31	11.53
Non-nitrogenous extract matter,	59.77	58.75	39.66	79.38	50.31	54.38	62.53	67.72
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Fertilizing Constituents.

[Nitrogen 15 cents, phosphoric acid 5½ cents, potassium oxide 4½ cents, per pound.]

FERTILIZER ANALYSES.	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	Corn and Cob Meal.	Corn Stover.	Corn Ensilage.	Corn Fodder.	Sugar Beets.
Moisture,	9.27	9.80	9.88	8.10	26.95	72.95	20.42	90.02
Nitrogen,	2.545	4.510	5.331	1.439	0.923	0.330	1.058	0.184
Phosphoric acid,	2.900	0.392	1.646	0.603	0.303	1.138	0.510	0.086
Potassium oxide,	1.637	0.049	1.162	0.441	1.320	0.301	0.760	0.462
Valuation per 2,000 pounds,	$13 60	$16 18	$21 15	$6 02	$4 69	$1 56	$4 89	$1 14

Average Composition of the Daily Fodder Rations used during the Six Successive Feeding Periods (First Winter Season, 1889–90).

I.

December 17 to December 31.

Wheat bran (pounds),	2.25
Gluten meal (pounds),	2.25
Corn stover (pounds),	12.00
Nutritive ratio,	1:5.51
Total cost (cents),	7.45
Manurial value obtainable (cents),	5.68
Net cost (cents),	1.77

II.

January 4 to January 22.

Wheat bran (pounds),	3.88
Gluten meal (pounds),	3.88
Corn ensilage (pounds),	37.50
Nutritive ratio,	1:5.49
Total cost (cents),	12.82
Manurial value obtainable (cents),	8.01
Net cost (cents),	4.81

III.

January 28 to February 16.

Wheat bran (pounds),	4.00
Old-process linseed meal (pounds),	4.00
Corn ensilage (pounds),	43.38
Nutritive ratio,	1:5.69
Total cost (cents),	14.76
Manurial value obtainable (cents),	9.50
Net cost (cents),	5.26

IV.

February 21 to March 11.

Wheat bran (pounds),	3.00
Old-process linseed meal (pounds),	3.00
Corn and cob meal (pounds),	3.00
Corn fodder (pounds),	9.00
Nutritive ratio,	1:4.93
Total cost (cents),	12.45
Manurial value obtainable (cents),	7.65
Net cost (cents),	4.80

V.

March 14 to April 21.

Wheat bran (pounds),	3.00
Old-process linseed meal (pounds),	3.00
Corn and cob meal (pounds),	3.00
Corn stover (pounds),	6.00
Nutritive ratio,	1:4.55
Total cost (cents),	10.58
Manurial value obtainable (cents),	6.92
Net cost (cents),	3.66

VI.

April 24 to May 9.

Wheat bran (pounds),	3.00
Old-process linseed meal (pounds),	3.00
Corn and cob meal (pounds),	3.00
Corn stover (pounds),	3.60
Sugar beets (pounds),	20.00
Nutritive ratio,	1:4.49
Total cost (cents),	14.98
Manurial value obtainable (cents),	7.44
Net cost (cents),	7.54

Summary of Cost of the Above-stated Average Daily Fodder Rations used.

[Cents.]

	Feeding Periods.					
	I.	II.	III.	IV.	V.	VI.
Total cost,	7.45	12.82	14.76	12.45	10.58	14.98
Manurial value obtainable,	5.68	8.01	9.50	7.65	6.92	7.44
Net cost,*	1.77	4.81	5.26	4.80	3.66	7.54

* Allowing ninety-two per cent. of the manurial value of the feed consumed obtainable.

As the selling price of live weight per pound of matured steers was 3¾ cents, it will be found that, to cover the daily expenses for feed consumed in form of the six stated average daily fodder rations, the following rate of a daily increase, per head, in pounds of live weight, becomes necessary: —

Gain required in Pounds, per Day, of Live Weight, to cover Expenses for Feed.

	Feeding Periods.					
	I.	II.	III.	IV.	V.	VI.
On total cost,	1.99	3.42	3.93	3.32	2.82	3.99
On net cost,	0.47	1.28	1.40	1.28	0.98	2.01

To what extent the various fodder rations have secured the above-specified increase in live weight may be seen from the subsequent detailed feeding record of each steer on trial: —

Steer No. 1 (Yearling).

FEEDING PERIODS.	FEED CONSUMED (POUNDS) PER DAY.								Total Amount of Dry Matter consumed per Day (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	Corn and Cob Meal.	Corn Stover.	Corn Ensilage.	Corn Fodder.	Sugar Beets.					
1889-90.													
Dec. 17 to Dec. 31,	2.27	2.33	–	–	5.27	–	–	–	7.82	1:4.63	675	654	-1.40
Jan. 4 to Jan. 22,	3.88	3.88	–	–	–	37.89	–	–	16.72	1:5.51	667	708	2.16
Jan. 28 to Feb. 16,	4.00	–	4.00	–	–	42.20	–	–	19.30	1:5.63	725	783	2.90
Feb. 21 to March 11,	3.00	–	3.00	3.00	–	–	9.42	–	15.68	1:4.98	785	820	1.84
March 14 to April 21,	3.00	–	3.00	3.00	5.91	–	–	–	12.50	1:4.54	828	880	1.33
April 24 to May 9,	3.00	–	3.00	3.00	3.50	–	–	20.00	12.74	1:4.47	882	895	0.81

	Pounds.
Live weight of animal at the beginning of the experiment,	675.00
Live weight of animal at the close of the experiment,	895.00
Live weight gained during the experiment,	220.00
Average gain in weight per day (entire experiment),	1.53
Highest average gain in live weight per day, III. period,	2.90
Lowest average gain in live weight per day, I. period,	-1.40

Steer No. 2 (Yearling).

FEEDING PERIODS.	Feed consumed (Pounds) per Day.								Total Amount of Dry Matter consumed per Day (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	Corn and Cob Meal.	Corn Stover.	Corn Ensilage.	Corn Fodder.	Sugar Beets.					
1889-90.													
Dec. 17 to Dec. 31,	2.00	2.07	–	–	5.27	–	–	–	6.53	1:4.76	600	590	–0.67
Jan. 4 to Jan. 22,	3.88	3.88	–	–	–	37.32	–	–	16.54	1:5.47	610	674	3.37
Jan. 28 to Feb. 16,	4.00	–	4.00	–	–	44.55	–	–	19.97	1:5.75	680	745	3.25
Feb. 21 to March 11,	3.00	–	3.00	3.00	–	–	8.53	–	14.97	1:4.87	746	770	1.26
March 14 to April 21,	3.00	–	3.00	3.00	6.00	–	–	–	12.56	1:4.55	776	826	1.28
April 24 to May 9,	3.00	–	3.00	3.00	3.69	–	–	20.00	12.88	1:4.50	828	840	0.75

	Pounds.
Live weight of animal at the beginning of the experiment,	600.00
Live weight of animal at the close of the experiment,	840.00
Live weight gained during the experiment,	240.00
Average gain in weight per day (entire experiment),	1.07
Highest average gain in live weight per day, II. period,	3.37
Lowest average gain in live weight per day, I. period,	–0.67

The first feeding period in case of both animals shows a decided loss in live weight; this result is presumably largely due to the influence of an entire change in mode of keeping and feeding, and cannot be charged to the daily diet.

2. *Record of Summer Pasturing.*

May 10, 1890, to Sept. 30, 1890.

	No. 1.	No. 2.
Date of turning steers into pasture, .	May 10, 1890.	May 10, 1890.
Date of closing pasturing, . . .	Sept. 30, 1890.	Sept. 30, 1890.
Number of days of pasturing, . .	144	144
Live weight of steers when turned into pasture, ...	895 lbs.	840 lbs.
Live weight of steers at close of pasturing, ...	1,020 "	923 "
Total weight gain during pasturing, .	125 "	83 "
Average gain in weight per day, . .	0.87 "	0.58 "
Cost of feed per day, allowing forty cents per week for use of pasture, .	5.71 cts.	5.71 cts.
Cost of feed per pound of live weight gained, ...	6.58 "	9.91 "

To meet the expenses for the use of the pasture, per head, forty cents a week, requires a daily increase in live weight of 1.52 pounds, or about twice as much as we actually secured. The daily increase in live weight no doubt varies during the season more or less, in consequence of changes in the weather and in the condition of the pasture. A mere statement of the final results at the close of the season does not show the degree of temporary adverse influence. Aside from these circumstances, there is, however, another serious source of loss in live weight; apparently unavoidably connected with a system of changing from stall feeding to pasturing, and from the latter again to stall feeding. The loss in live weight due to these changes amounted in our case to from twenty to twenty-five pounds, per head, on each occasion and in case of both animals.

3. *Feeding Record of Second Winter Season.*

Oct. 14, 1890, to March 3, 1891.

[Coarse fodder articles: upland meadow hay, barley straw, clover hay, corn ensilage, turnips; fine fodder articles: barley meal, wheat bran, cotton-seed meal.]

The steers, upon returning from the pasture, September 30, were allowed for a week or more, some hours every day, an out-door exercise, to make the change for a subsequent close confinement and a systematic system of feeding a gradual one. The mode of feeding was the same as during the preceding winter season. The daily grain-feed rations consisted either of wheat bran and cotton-seed meal, 3.5 pounds each, per head, or of wheat bran, barley meal and cotton-seed meal, varying from 3 to 3.5 pounds each, per head, at different times. The daily coarse-feed ration consisted at different times in varying proportions either of English hay, or of English hay and barley straw, or of English hay, clover hay and turnips, or of clover hay and corn ensilage; the amount consumed was controlled by the appetite of each animal on trial. The subsequent detailed statement of fodder rations used represents in each case the average composition of the daily diet during succeeding feeding periods. The change from one daily diet to another is in all cases a gradual one, to avoid as far as practicable serious disturbances in digestion.

Local Market Cost per Ton of the Various Articles of Fodder used.

Wheat bran,	$23 50
Barley meal,	30 00
Cotton-seed meal,	27 50
Barley straw,	5 00
Hay,	15 00
Clover hay,	12 00
Turnips,	4 00
Corn ensilage,	2 75

Analyses of the Various Articles of Fodder used.

FOOD ANALYSES.	Wheat Bran.	Barley Meal.	Cotton-seed Meal.	Barley Straw.	Hay.	Clover Hay.	Turnips.	Corn Ensilage.
Moisture at 100° C.,	12.11	14.62	10.13	11.44	9.72	17.41	89.32	80.53
Dry matter,	87.89	85.38	89.87	88.56	90.28	82.59	10.68	19.47
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Analysis of Dry Matter.								
Crude ash,	7.40	3.18	8.22	5.30	6.43	14.98	9.54	6.73
" cellulose,	12.17	5.04	7.26	33.85	32.28	30.37	12.61	26.90
" fat,	5.04	2.38	11.64	3.38	2.49	1.75	2.05	3.27
" protein,	18.48	14.93	45.99	9.24	9.54	16.64	9.89	8.97
Non-nitrogenous extract matter,	56.91	74.47	26.89	48.23	49.26	36.26	65.91	54.13
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Fertilizing Constituents.

[Nitrogen 15 cents, phosphoric acid 5½ cents, potassium oxide 4½ cents, per pound.]

FERTILIZER ANALYSES.	Wheat Bran.	Barley Meal.	Cotton-seed Meal.	Barley Straw.	Hay.	Clover Hay.	Turnips.	Corn Ensilage.
Moisture,	12.11	14.62	10.13	11.44	9.72	17.41	89.32	80.53
Nitrogen,	2.697	2.04	6.613	1.310	1.379	2.20	1.69	0.279
Phosphoric acid,	2.870	0.660	2.090	0.303	0.352	0.603	0.092	0.096
Potassium oxide,	1.620	0.341	1.620	2.086	1.541	1.962	0.358	0.226
Valuation per 2,000 pounds,	$12 71	$7 16	$23 60	$6 14	$5 92	$9 03	$0 93	$1 15

Average Composition of the Daily Fodder Rations used during the Six Successive Feeding Periods (Second Winter Season, 1890–91).

I.

October 14 to October 25.

Wheat bran (pounds),	3.50
Cotton-seed meal (pounds),	3.50
Barley straw (pounds),	6.42
Hay (pounds),	8.33
Nutritive ratio,	1 : 4.15
Total cost (cents),	16.78
Manurial value obtainable (cents),	9.93
Net cost (cents),	6.85

II.

October 28 to November 10.

Wheat bran (pounds),	3.50
Cotton-seed meal (pounds),	3.50
Hay (pounds),	15.68
Nutritive ratio,	1 : 4.08
Total cost (cents),	20.68
Manurial value obtainable (cents),	10.11
Net cost (cents),	10.57

III.

November 13 to December 1.

Wheat bran (pounds),	2.50
Cotton-seed meal (pounds),	3.50
Hay (pounds),	7.53
Clover hay (pounds),	7.72
Turnips (pounds),	30.00
Nutritive ratio,	1 : 3.75
Total cost (cents),	25.2
Manurial value obtainable (cents),	12.38
Net cost (cents),	12.82

IV.

December 2 to December 15.

Wheat bran (pounds),	2.50
Barley meal (pounds),	2.50
Cotton-seed meal (pounds),	2.50
Hay (pounds),	7.04
Clover hay (pounds),	6.15
Turnips (pounds),	30.00
Nutritive ratio,	1 : 4.28
Total cost (cents),	25.10
Manurial value obtainable (cents),	10.75
Net cost (cents),	14.35

V.

December 16 to January 19.

Wheat bran (pounds),	3.32
Barley meal (pounds),	3.32
Cotton-seed meal (pounds),	3.32
Hay (pounds),	6.44
Clover hay (pounds),	5.34
Turnips (pounds),	30.00
Nutritive ratio,	1 : 4.01
Total cost (cents),	27.48
Manurial value obtainable (cents),	11.89
Net cost (cents),	15.59

VI.

January 27 to March 2.

Wheat bran (pounds),	3.00
Barley meal (pounds),	3.00
Cotton-seed meal (pounds),	3.00
Clover hay (pounds),	5.07
Corn ensilage (pounds),	42.45
Nutritive ratio,	1 : 4.11
Total cost (cents),	21.05
Manurial value obtainable (cents),	10.34
Net cost (cents),	10.71

Summary of Cost of the Above-stated Average Daily Fodder Rations used.

[Cents.]

	Feeding Periods.					
	I.	II.	III.	IV.	V.	VI.
Total cost, . . .	16.78	20.68	25.20	25.10	27.48	21.05
Manurial value obtainable, ...	9.93	10.11	12.38	10.75	11.89	10.34
Net cost,* . . .	6.85	10.57	12.82	14.35	15.59	10.71

* Allowing ninety-two per cent. of the manurial value of the feed consumed obtainable.

Taking the selling price of dressed beef at 3¾ cents per pound, it follows that, to cover the daily expenses for feed consumed in the form of the above specified six daily fodder rations, the following rate of daily increase in pounds of live weight becomes necessary: —

Gain required in Pounds, per Day, of Live Weight, to cover Expenses for Feed.

	Feeding Periods.					
	I.	II.	III.	IV.	V.	VI.
On total cost, . .	4.47	5.51	6.72	6.69	7.33	5.61
On net cost, . . .	1.83	2.82	3.42	3.83	4.16	2.86

The subsequent detailed record of each steer on trial shows to what extent each of the previously specified fodder rations has realized the required increase in live weight.

Conclusions.

1. The rate of increase in live weight was highest during the first winter season, 1889–90. The daily increase in live weight averaged in case of steer No. 1, 2.5 pounds, and in the case of steer No. 2, 3.3 pounds, for a period of six weeks, when fodder rations II. and III. were fed. The market value of the stated daily increase in live weight, at 3¾ cents per pound, would amount to 9.4 cents in case of steer No. 1, and to 12.4 cents in case of steer No. 2. As the market cost of these two fodder rations averages 13.8 cents and

their net cost 5.03 cents, it will be noticed that the value gained by the stated increase in live weight does in neither case pay fully for the food consumed for its production; yet there remains a noticeable margin of profit on the net cost of the daily feed in the form of obtainable manure; *i. e.*, 4.37 cents per day in case of steer No. 1, and 7.37 cents in case of steer No. 2.

2. The average of the daily increase in the live weight of the steers during the entire period of pasture feeding amounted, in case of steer No. 1, to .87 pounds, and in the case of steer No. 2 to .58 pounds. This increase in live weight represents on an average a market value of 3.18 cents in case of the former, and in that of the latter of 2.18 cents. Our expenses for the use of the pasture, per head, was 40 cents per week, or 5.7 cents per day. We lost, per head, 3 cents per day, or 21 cents per week, on each animal; not counting expenses for transportation to and from the pasture, loss of interest on the investment, etc.

3. The financial results of the second winter feeding are less satisfactory than those secured during the first winter feeding. This fact is due to two circumstances, namely, higher market cost of several coarse and fine fodder articles used, and less nutritive effect of the fodder rations experimented with. The daily increase in live weight did at no time exceed 2.33 pounds per head. The market cost of the various daily fodder rations used during the time stated varied from 16.8 cents to 27.48 cents per head, while their net cost differed from 6.85 cents to 15.59 cents. The highest temporary increase in live weight noticed, per day, 2.33 pounds, would realize in our market only 12.37 cents, which amount is still 4.5 cents less than the market cost of the cheapest daily fodder ration, I. period, used.

The results of the second feeding experiment emphasize the statements made in connection with the report of our first experiment, namely, cheaper and more efficient fodder rations than most of our grass lands — meadows and pastures — can furnish have to be devised to render the production of beef for our meat markets remunerative.

Our observations with growing steers have been continued, and feeding experiments carried on without the assistance of summer pasturing are well advanced.

Steer No. 1.

FEEDING PERIODS.	FEED CONSUMED (POUNDS) PER DAY.								Total Amount of Dry Matter consumed per Day (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
	Wheat Bran.	Barley Meal.	Cotton-seed Meal.	Barley Straw.	Hay.	Clover Hay.	Turnips.	Corn Ensilage.					
1890-91.													
Oct. 14 to Oct. 25,	3.50	–	3.50	7.00	8.33	–	–	–	19.96	1:4.22	1,060	1,085	2.08
Oct. 28 to Nov. 10,	3.50	–	3.50	–	16.53	–	–	–	21.16	1:4.16	1,095	1,083	-0.75
Nov. 13 to Dec. 1,	3.50	–	3.50	–	8.00	8.10	30.00	–	23.35	1:3.78	1,096	1,140	2.32
Dec. 2 to Dec. 15,	2.50	2.50	2.50	–	8.00	7.00	30.00	–	22.79	1:4.34	1,140	1,165	1.79
Dec. 16 to Jan. 19,	3.50	3.50	3.50	–	7.13	6.14	30.00	–	23.94	1:3.99	1,165	1,238	2.09
Jan. 27 to March 2,	3.00	3.00	3.00	–	–	4.91	–	49.40	21.59	1:4.28	1,240	1,320	2.29

	Pounds.
Weight of animal at the beginning of the experiment,	1,020.00
Weight of animal at the time of killing,	1,328.00
Live weight gained during the experiment,	308.00
Average gain in weight per day (entire experiment),	1.90
Highest average gain in live weight per day, III. period,	2.32
Lowest average gain in live weight per day, II. period,	-0.75

Steer No. 2.

FEEDING PERIODS.	FEED CONSUMED (POUNDS) PER DAY.								Total Amount of Dry Matter consumed per Day (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
	Wheat Bran.	Barley Meal.	Cotton-seed Meal.	Barley Straw.	Hay.	Clover Hay.	Turnips.	Corn Ensilage.					
1890-91.													
Oct. 14 to Oct. 25, . .	3.50	–	3.50	5.83	8.33	–	–	–	18.92	1:4.07	980	1,008	2.33
Oct. 28 to Nov. 10, . .	3.50	–	3.50	–	14.82	–	–	–	19.62	1:4.00	1,018	1,012	–0.43
Nov. 13 to Dec. 1, . .	3.50	–	3.50	–	7.05	7.34	30.00	–	21.86	1:3.72	1,022	1,040	0.95
Dec. 2 to Dec. 15, . .	2.50	2.50	2.50	–	6.07	5.29	30.00	–	19.64	1:4.23	1,040	1,053	0.93
Dec. 16 to Jan. 19, . .	3.14	3.14	3.14	–	5.74	4.54	30.00	–	20.41	1:4.02	1,053	1,120	1.91
Jan. 27 to March 2, . .	3.00	3.00	3.00	–	–	5.23	–	35.50	19.14	1:3.93	1,125	1,155	0.85

	Pounds.
Weight of animal at the beginning of the experiment, ...	923.00
Weight of animal at the time of killing, ...	1,154.00
Live weight gained during the experiment, ...	231.00
Average gain in weight per day (entire experiment), ...	1.43
Highest average gain in live weight per day, I. period, ...	2.33
Lowest average gain in live weight per day, II. period, ...	–0.43

THIRD FEEDING EXPERIMENT WITH STEERS.

October, 1890, to May, 1892.

Three one-year-old steers, grade Shorthorn, were selected for the trial. They were bought at 3½ cents per pound of live weight on Oct. 14, 1890. No. 1 weighed 655 pounds, No. 2 weighed 595 pounds and No. 3 weighed 629 pounds.

The mode of feeding and the general management of the third experiment corresponded in all essentials with the course adopted in the second feeding experiment, previously described. The third experiment is divided, as the second, and for similar reasons, into three distinctly different stages of progress, namely, *feeding record* of *first winter season*, of *summer pasturing* and of *second winter season*.

1. Feeding Record of First Winter Season.

Oct. 14, 1890, to April 20, 1891.

[Coarse fodder articles: upland meadow hay, barley straw, clover hay, corn ensilage and turnips; fine fodder articles: wheat bran and cotton-seed meal.]

Local Market Cost per Ton of the Various Articles of Fodder used.

Wheat bran,	$23 50
Cotton-seed meal,	27 50
Barley straw,	5 00
Hay,	15 00
Mixed fodder,	12 00
Turnips,	7 00
Corn ensilage,	2 75

Analyses of the Various Articles of Fodder used.

FOOD ANALYSES.	Wheat Bran.	Cotton-seed Meal.	Barley Straw.	Hay.	Mixed Fodder.	Turnips.	Corn Ensilage.
Moisture at 100° C.,	12.11	10.13	11.44	9.72	17.41	89.32	80.53
Dry matter,	87.89	89.87	88.56	90.28	82.59	10.68	19.47
	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Analysis of Dry Matter.							
Crude ash,	7.40	8.22	5.30	6.43	14.98	9.54	6.73
" cellulose,	12.17	7.26	33.85	32.28	30.37	12.61	26.90
" fat,	5.04	11.64	3.38	2.49	1.75	2.05	3.27
" protein,	18.48	45.99	9.24	9.54	16.64	9.89	8.97
Non-nitrogenous extract matter,	56.91	26.89	48.23	49.26	36.26	65.91	54.13
	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Fertilizing Constituents.

[Nitrogen 15 cents, phosphoric acid 5½ cents, potassium oxide 4½ cents, per pound.]

FERTILIZER ANALYSES.	Wheat Bran.	Cotton-seed Meal.	Barley Straw.	Hay.	Mixed Fodder.	Turnips.	Corn Ensilage.
Moisture,	12.11	10.13	11.44	9.72	17.41	89.32	80.53
Nitrogen,	2.60	6.613	1.31	1.379	2.20	0.169	0.279
Phosphoric acid,	2.87	2.09	0.303	0.352	0.603	0.092	0.096
Potassium oxide,	1.62	1.62	2.086	1.541	1.962	0.358	0.226
Valuation per 2,000 pounds,	$12 42	$23 60	$6 14	$5 92	$9 03	$0 93	$1 15

Average Composition of the Daily Fodder Rations used during the Seven Successive Feeding Periods (First Winter Season, 1890–91).

I.

October 14 to October 25.

Wheat bran (pounds),	2.00
Cotton-seed meal (pounds),	2.00
Barley straw (pounds),	4.67
Hay (pounds),	5.95
Nutritive ratio,	1:4.56
Total cost (cents),	10.73
Manurial value obtainable (cents),	6.27
Net cost (cents),	4.46

II.

October 28 to November 10.

Wheat bran (pounds),	2.00
Cotton-seed meal (pounds),	2.00
Hay (pounds),	11.50
Nutritive ratio,	1:4.48
Total cost (cents),	13.73
Manurial value obtainable (cents),	6.47
Net cost (cents),	7.26

III.

November 13 to December 15.

Wheat bran (pounds),	2.00
Cotton-seed meal (pounds),	2.00
Hay (pounds),	5.43
Mixed fodder (pounds),	5.66
Turnips (pounds),	20.00
Nutritive ratio,	1:3.94
Total cost (cents),	16.57
Manurial value obtainable (cents),	8.02
Net cost (cents),	8.55

IV.

December 16 to January 19.

Wheat bran (pounds),	3.00
Cotton-seed meal (pounds),	3.00
Hay (pounds),	5.08
Mixed fodder (pounds),	4.83
Turnips (pounds),	20.00
Nutritive ratio,	1:3.51
Total cost (cents),	18.36
Manurial value obtainable (cents),	9.26
Net cost (cents),	9.10

Average Composition, etc. — Concluded.

V.		VI.	
January 27 to March 6.		*March 10 to March 24.*	
Wheat bran (pounds),	3.00	Wheat bran (pounds),	3.00
Cotton-seed meal (pounds),	3.00	Cotton-seed meal (pounds),	3.00
Mixed fodder (pounds),	5.33	Hay (pounds),	6.84
Corn ensilage (pounds),	33.25	Mixed fodder (pounds),	6.52
Nutritive ratio,	1:3.46	Nutritive ratio,	1:3.24
Total cost (cents),	15.44	Total cost (cents),	16.66
Manurial value obtainable (cents),	8.99	Manurial value obtainable (cents),	9.52
Net cost (cents),	6.45	Net cost (cents),	7.14

VII.	
March 25 to April 20.	
Wheat bran (pounds),	5.00
Cotton-seed meal (pounds),	3.00
Hay (pounds),	11.00
Nutritive ratio,	1:3.78
Total cost (cents),	16.69
Manurial value obtainable (cents),	9.58
Net cost (cents),	7.11

Summary of Cost of the Above-stated Average Daily Fodder Rations used.

[Cents.]

	FEEDING PERIODS.						
	I.	II.	III.	IV.	V.	VI.	VII.
Total cost,	10.73	13.73	16.57	18.36	15.44	16.66	16.69
Manurial value obtainable,	6.27	6.47	8.02	9.26	8.99	9.52	9.58
Net cost,*	4.46	7.26	8.55	9.10	6.45	7.14	7.11

* Allowing ninety-two per cent. of the manurial value of the feed consumed obtainable.

Accepting as basis of calculation the selling price of dressed beef, 3¾ cents per pound, it will be noticed that, to cover the daily expenses for feed consumed in form of the previously specified seven daily fodder rations, the following rates in the daily increase in pounds of live weight become necessary: —

Gain required in Pounds, per Day, of Live Weight, to cover Expenses for Feed.

	Feeding Periods.						
	I.	II.	III.	IV.	V.	VI.	VII.
On total cost, . .	2.86	3.66	4.42	4.89	4.12	4.44	4.45
On net cost, . .	1.19	1.93	2.28	2.43	1.72	1.90	1.90

The following detailed record of each steer on trial shows to what extent each of the previously described fodder rations has materialized the necessary increase in live weight: —

Steer No. 1 (Yearling).

FEEDING PERIODS.	Feed consumed (Pounds) per Day.							Total Amount of Dry Matter consumed per Day (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
	Wheat Bran.	Cotton-seed Meal.	Barley Straw.	Hay.	Mixed Fodder.	Turnips.	Corn Ensilage.					
1890-91.												
Oct. 14 to Oct. 25,	2.00	2.00	5.00	6.33	–	–	–	13.71	1 : 4.68	655	685	2.50
Oct. 28 to Nov. 10,	2.00	2.00	–	11.46	–	–	–	13.92	1 : 4.47	693	692	-0.07
Nov. 13 to Dec. 15,	2.00	2.00	–	5.27	5.42	20.00	–	14.95	1 : 3.93	697	746	2.50
Dec. 16 to Jan. 19,	3.00	3.00	–	5.06	5.23	20.00	–	16.38	1 : 3.51	746	784	1.09
Jan. 27 to March 6,	3.00	3.00	–	–	5.33	–	34.46	16.46	1 : 3.62	788	825	0.95
March 10 to March 24,	3.00	3.00	–	5.87	6.43	–	–	15.96	1 : 3.13	822	851	1.93
March 25 to April 20,	5.00	3.00	–	10.57	–	–	–	16.66	1 : 3.74	851	853	0.07

	Pounds.
Live weight of animal at the beginning of the experiment,	655.00
Live weight of animal at the close of the experiment,	853.00
Live weight of animal gained during the experiment,	198.00
Average gain of weight per day (entire experiment),	1.05
Highest average gain in live weight per day, I. period,	2.50
Lowest average gain in live weight per day, II. period,	-0.07

Steer No. 2 (Yearling).

FEEDING PERIODS.	FEED CONSUMED (POUNDS) PER DAY.							Total Amount of Dry Matter consumed per Day (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
	Wheat Bran.	Cotton-seed Meal.	Barley Straw.	Hay.	Mixed Fodder.	Turnips.	Corn Ensilage.					
1890-91.												
Oct. 14 to Oct. 25,	2.00	2.00	3.88	5.42	–	–	–	11.90	1:4.31	593	602	0.75
Oct. 28 to Nov. 10,	2.00	2.00	–	10.61	–	–	–	13.15	1:4.35	605	630	1.79
Nov. 13 to Dec. 15,	2.00	2.00	–	5.29	5.45	20.00	–	15.00	1:3.93	633	690	1.73
Dec. 16 to Jan. 19,	3 00	3.00	–	5.11	4.11	20.00	–	15.49	1:3.52	690	735	1.29
Jan. 27 to March 6,	3.00	3.00	–	–	5.27	–	29.51	15.45	1:3.10	755	798	1.10
March 10 to March 24,	3.00	3.00	–	7.13	5.73	–	–	16.52	1:3.28	794	838	2.93
March 25 to April 20,	5.00	3.00	–	10.41	–	–	–	16.52	1:3.72	838	843	0.19

	Pounds.
Live weight of animal at the beginning of the experiment,	593.00
Live weight of animal at the close of the experiment,	843.00
Live weight gained during the experiment,	250.00
Average gain in weight per day (entire experiment),	1.32
Highest average gain in live weight per day, VI. period,	2.93
Lowest average gain in live weight per day, VII. period,	0.19

Steer No. 3 (Yearling).

FEEDING PERIODS.	FEED CONSUMED (POUNDS) PER DAY.							Total Amount of Dry Matter consumed per Day (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
	Wheat Bran.	Cotton-seed Meal.	Barley Straw.	Hay.	Mixed Fodder.	Turnips.	Corn Ensilage.					
1890-91.												
Oct. 14 to Oct. 25,	2.00	2.00	5.13	6.12	–	–	–	13.64	1:4.68	626	647	1.75
Oct. 28 to Nov. 10,	2.00	2.00	–	12.54	–	–	–	14.89	1:4.62	655	675	1.43
Nov. 13 to Dec. 15,	2.00	2.00	–	5.73	6.12	20.00	–	15.93	1:3.97	681	715	1.03
Dec. 16 to Jan. 19,	3.00	3.00	–	5.00	5.14	20.00	–	16.25	1:3.50	715	760	1.29
Jan. 27 to March 6,	3.00	3.00	–	–	5.38	–	35.67	16.73	1:3.66	741	836	2.44
March 10 to March 24,	3.00	3.00	–	7.53	7.40	–	–	18.26	1:3.32	830	878	3.20
March 25 to April 20,	5.00	3.00	–	11.80	–	–	–	17.77	1:3.87	878	870	-0.30

	Pounds.
Live weight of animal at the beginning of the experiment,	626.00
Live weight of animal at the close of the experiment,	870.00
Live weight gained during the experiment,	244.00
Average gain in weight per day (entire experiment),	1.29
Highest average gain in live weight per day, VI. period,	3.20
Lowest average gain in live weight per day, VII. period,	-0.30

2. *Record of Summer Pasturing.*

April 27, 1891, to Nov. 3, 1891.

	No. 1.	No. 2.	No. 3.
Date of turning steers into pasture,	April 27, 1891.	April 27, 1891.	April 27, 1891.
Date of closing pasturing,	Nov. 3, 1891.	Nov. 3, 1891.	Nov. 3, 1891.
Number of days of pasturing,	190	190	190
Live weight of steers when turned into pasture,	830 lbs.	805 lbs.	848 lbs.
Live weight of steers at close of pasturing,	925 "	926 "	955 "
Total weight gained during pasturing,	95 "	121 "	107 "
Average gain in weight per day,	0.50 "	0.64 "	0.56 "
Cost of feed, allowing twenty-five cents per week for use of pasture,	$6 78	$6 78	$6 78
Cost of feed per pound of live weight gained,	7.14 cts.	5.60 cts.	6.33 cts.

The average gain in live weight per day, per head, was 0.95 pounds. To meet the expenses for the use of the pasture, which was 25 cents, per head, for the week, requires an increase in live weight of one pound, leaving our outlay for moving the steers to the pasture and back again without a return. Adding to this result the unavoidable falling off in live weight, due to a change in mode of living, it is apparent that pasturing without an additional supply of feed from outside sources is apt to prove an unprofitable delay in the maturing of young steers for the meat market.

To demonstrate, if possible, the correctness of this view, our more recent experiments with feeding young steers for the meat market are carried on without the assistance of the pasture. The animal is fed in the stable during the entire experiment, without any out-door exercise beyond the requirements of good health.

3. *Feeding Record of Second Winter Season.*

Nov. 10, 1891, to May 16, 1892.

[Coarse fodder articles: upland meadow hay, dent corn ensilage, sweet corn ensilage, corn stover, sugar beets, globe mangolds and turnips; fine fodder articles: wheat bran, maize feed (Chicago) and gluten feed (Buffalo).]

The steers returning from the pasture November 3, were for a week allowed out-door exercise between the times of feeding, to make the change for subsequent close confinement a gradual one.

The system of feeding remained materially the same as on previous occasion. The daily ration of grain feed was a definite one for each period, and the same in quantity for each animal at the time. It consisted during the first five periods of equal weights of wheat bran and Chicago maize feed, from 3.44 to 4 pounds each, and during the last feeding period (VI.) of equal weights of wheat bran and Buffalo gluten feed, 4 pounds each, per head, daily. The daily coarse fodder ration consisted at different times of either English hay with roots, or of corn ensilage. The amount of roots was a definite one, and the same in case of all animals; while the daily amount of hay and of corn ensilage consumed was controlled by the appetite of each steer.

The following detailed description of the six fodder rations fed during the succeeding feeding periods represents the average composition of the daily diet. Changes from one diet to another were made gradually for obvious reasons, allowing six days to pass by before recording results.

Local Market Cost per Ton of the Various Articles of Fodder used.

Wheat bran,	$22 00
Maize feed,	25 00
Gluten feed,	23 00
Hay,	15 00
Turnips,	2 50
Globe mangolds,	4 00
Dent corn ensilage,	2 50
Sweet corn ensilage,	2 50
Corn stover,	5 00
Sugar beets,	5 00

Analyses of Fine Feed used.

[Grain Feed.]

FOOD ANALYSES.	Wheat Bran.	Maize Feed.	Gluten Feed.
Moisture at 100° C.,	10.01	8.70	8.97
Dry matter,	89.99	91.30	91.03
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	6.58	0.78	0.77
" cellulose,	11.77	7.97	5.09
" fat,	5.04	7.37	13.46
" protein,	18.06	27.55	26.16
Non-nitrogenous extract matter,	58.55	56.33	54.52
	100.00	100.00	100.00

Fertilizing Constituents.

[Nitrogen 15 cents, phosphoric acid 5½ cents, potassium oxide 4½ cents, per pound.]

FERTILIZER ANALYSES.	Wheat Bran.	Maize Feed.	Gluten Feed.
Moisture,	10.01	8.70	8.97
Nitrogen,	2.60	4.03	3.81
Phosphoric acid,	2.85	0.70	0.69
Potassium oxide,	1.63	0.43	0.42
Valuation per 2,000 pounds,	$12 40	$13 25	$12 57

Analyses of Coarse Fodder Articles used.

FOOD ANALYSES.	Hay.	Turnips.	Globe Mangolds.	Dent Corn Ensilage.	Sweet Corn Ensilage.	Corn Stover.	Sugar Beets.
Moisture at 100° C.,	9.72	90.21	87.75	79.92	84.30	20.10	85.27
Dry matter,	90.28	9.79	12.25	20.08	15.70	79.90	14.73
	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Analysis of Dry Matter.							
Crude ash,	6.43	8.47	9.06	4.99	6.32	6.12	5.95
" cellulose,	32.28	11.23	7.94	27.19	29.32	33.72	6.49
" fat,	2.49	1.74	0.88	3.29	7.36	2.51	0.66
" protein,	9.54	10.12	10.37	8.29	7.86	7.75	10.97
Non-nitrogenous extract matter,	49.26	68.44	71.75	56.24	49.14	49.90	75.93
	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Fertilizing Constituents.

[Nitrogen 15 cents, phosphoric acid 5½ cents, potassium oxide 4½ cents, per pound.]

FERTILIZER ANALYSES.	Hay.	Turnips.	Globe Mangolds.	Dent Corn Ensilage.	Sweet Corn Ensilage.	Corn Stover.	Sugar Beets.
Moisture,	9.72	90.21	87.75	79.92	84.30	20.10	85.27
Nitrogen,	1.38	0.178	0.203	0.27	0.20	0.99	0.26
Phosphoric acid,	0.36	0.104	0.093	0.14	0.089	0.29	0.10
Potassium oxide,	1.57	0.385	0.383	0.33	0.41	1.40	0.48
Valuation per 2,000 pounds,	$5 95	$0 99	$1 06	$1 26	$1 06	$4 55	$1 32

Average Composition of the Daily Fodder Rations used during the Six Successive Feeding Periods (Second Winter Season, 1891–92).

I.

November 10 to December 22.

Wheat bran (pounds),	3.44
Maize feed (pounds),	3.44
Hay (pounds),	11.03
Turnips (pounds),	17.38
Nutritive ratio,	1:5.83
Total cost (cents),	18.53
Manurial value obtainable (cents),	7.87
Net cost (cents),	10.66

II.

December 29 to January 30.

Wheat bran (pounds),	4.00
Maize feed (pounds),	4.00
Hay (pounds),	9.17
Globe mangolds (pounds),	15.00
Nutritive ratio,	1:5.42
Total cost (cents),	19.28
Manurial value obtainable (cents),	7.95
Net cost (cents),	11.33

III.

January 19 to February 23.

Wheat bran (pounds),	4.00
Maize feed (pounds),	4.00
Dent corn ensilage (pounds),	33.88
Nutritive ratio,	1:5.25
Total cost (cents),	13.64
Manurial value obtainable (cents),	6.68
Net cost (cents),	6.96

IV.

March 1 to March 23.

Wheat bran (pounds),	4.00
Maize feed (pounds),	4.00
Sweet corn ensilage (pounds)	57.41
Nutritive ratio,	1:5.92
Total cost (cents),	16.58
Manurial value obtainable (cents),	7.52
Net cost (cents),	9.06

Average Composition, etc. — Concluded.

V.		VI.	
March 29 to April 9.		*April 26 to May 16.*	
Wheat bran (pounds),	4.00	Wheat bran (pounds),	4.00
Maize feed (pounds),	4.00	Gluten feed (pounds),	4.00
Corn stover (pounds),	11.23	Hay (pounds),	10.00
Nutritive ratio,	1:5.67	Sugar beets (pounds),	15.00
Total cost (cents),	12.21	Nutritive ratio,	1:5.83
Manurial value obtainable (cents),	7.06	Total cost (cents),	20.25
Net cost (cents),	5.15	Manurial value obtainable (cents),	8.24
		Net cost (cents),	12.01

Summary of Cost of the Above-stated Average Daily Fodder Rations used.

[Cents.]

	FEEDING PERIODS.					
	I	II.	III.	IV.	V.	VI
Total cost,	18.53	19.28	13.64	16.58	12.21	20.25
Manurial value obtainable,	7.87	7.95	6.68	7.52	7.06	8.24
Net cost,*	10.66	11.33	6.96	9.06	5.15	12.01

* Allowing ninety-two per cent. of the manurial value of the feed consumed obtainable.

Gain required in Pounds, per Day, of Live Weight, to cover Expenses for Feed.

	FEEDING PERIODS.					
	I.	II.	III.	IV.	V.	VI.
On total cost,	4.94	5.14	3.64	4.42	3.26	5.40
On net cost,	2.84	3.02	1.86	2.42	1.37	3.20

How far in the case of each steer these rates of daily increase in their live weight have been realized in case of each specified fodder ration may be seen from the subsequent detailed feeding record of each animal.

Conclusions.

The results of the third feeding experiment with young steers do not materially differ in their general aspect from those obtained in our two preceding experiments.

1. During the first winter season the daily gain in live weight during the sixth feeding period reached 3.2 pounds (steer No. 3), and it averaged for the entire lot of steers (three) at that time 2.69 pounds per head. This gain represents 0.34 pounds on every one hundred pounds of live weight of the animal on trial (800 pounds each).

2. During the second winter season the same lot of steers gained, during one feeding period (I. period), on an average, 2.5 pounds of live weight per day; in case of one steer it was as high as 3.05 pounds per day. This rate of daily increase in live weight is equal to 0.21 pounds on each hundred pounds of live weight, with a total weight of 1,100 pounds per head.

3. The total local market cost of the different stated daily fodder rations used during the first winter season varies from 10.7 to 18.36 cents, and their net cost from 4.46 to 9.10 cents, leaving manurial refuse equal in commercial value to one-half of the local retail market cost of the feed consumed.

4. The total local market cost of the daily fodder rations used during the second winter season varies from 12.2 to 20.28 cents, and their net cost from 5.1 to 12.01 cents, leaving a manurial refuse equal to two-fifths of the local retail market cost of the fodder articles which constitute the stated fodder rations.

5. The average daily gain in live weight, taking the entire experiment into consideration, is somewhat higher than that noticed in the second experiment; yet at no period of the trial does the daily increase in live weight at $3\frac{3}{4}$ cents market cost per pound of live weight equal the entire local market cost of the feed consumed in connection with its production. This result is due in some degree, no doubt, to the contemporary high local market cost of some of the fodder ingredients largely used in the making up of the daily fodder rations.

The results of our experiments in this connection are, as may be noticed from preceding reports, rather more instructive than remunerative. A market cost of 3½ cents per pound of live weight in cases of yearlings, with 3¾ cents per pound of live weight in cases of matured steers, leaves, it will be conceded, but a small margin of cash profits. The largest daily increase in live weight, in case of any diet thus far experimented with, was 0.46 pounds per one hundred pounds of live weight, with yearlings weighing from 650 to 700 pounds per head; while in case of two-year-old steers, weighing from 1,100 to 1,150 pounds per head, it reached but 0.3 pounds for every one hundred pounds of their live weight. The highest daily increase in live weight during any feeding period in case of yearlings thus far secured by us amounted to 2.9 pounds per head, and in case of two-year-olds to 3.4 pounds per head. These results represent a market value of live weight gained at above-stated local meat market prices of 10.87 cents in case of yearlings, and 12.55 cents in case of two-year-old steers. Our results fall behind daily, thus far, about one pound of gain in live weight to cover the market cost of the feed consumed for its production; 14 to 15 cents in case of yearlings, 18 to 19 cents in case of two-year-old steers.

The necessity of efficient and cheap fodder rations being quite evident, it seems desirable to try, more generally, fodder crops of a higher nutritive character than the majority of our meadows and pastures furnishes at present.

Steer No. 1.

FEEDING PERIODS.	FEED CONSUMED (POUNDS) PER DAY.										Total Amount of Dry Matter consumed per Day (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
	Wheat Bran.	Maize Feed.	Gluten Feed.	Hay.	Turnips.	Globe Mangolds.	Dent Corn Ensilage.	Sweet Corn Ensilage.	Corn Stover.	Sugar Beets.					
1891-92.															
Nov. 10 to Dec. 22,	3.44	3.44	–	12.17	17.38	–	–	–	–	–	18.92	1:5.91	925	1,020	2.26
Dec. 29 to Jan. 13,	4.00	4.00	–	9.25	–	15.00	–	–	–	–	17.44	1:5.50	1,050	1,060	0.67
Jan. 19 to Feb. 23,	4.00	4.00	–	–	–	–	32.87	–	–	–	13.85	1:5.24	1,085	1,100	0.43
March 1 to March 23,	4.00	4.00	–	–	–	–	–	65.01	–	–	17.46	1:5.99	1,120	1,170	2.27
March 29 to April 9,	4.00	4.00	–	–	–	–	–	–	11.45	–	16.40	1:5.70	1,140	1,140	0.00
April 26 to May 16,	4.00	–	4.00	10.00	–	–	–	–	–	15.00	18.48	1:5.83	1,202	1,225	1.15

	Pounds.
Live weight of animal at the beginning of the experiment,	925.00
Live weight of animal at the time of killing,	1,225.00
Live weight gained during the experiment,	300.00
Average gain in weight per day (entire experiment),	1.60
Highest average gain in live weight per day, IV. period,	2.27
Lowest average gain in live weight per day, V. period,	0.00

Steer No. 2.

Feeding Periods.	Feed consumed (Pounds) per Day.										Total Amount of Dry Matter consumed per Day (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
	Wheat Bran.	Maize Feed.	Gluten Feed.	Hay.	Turnips.	Globe Mangolds.	Dent Corn Ensilage.	Sweet Corn Ensilage.	Corn Stover.	Sugar Beets.					
1891-92.															
Nov. 10 to Dec. 22, .	3.44	3.44	–	9.81	17.38	–	–	–	–	–	16.79	1 : 5.70	926	1,018	2.19
Dec. 29 to Jan. 13, .	4.00	4.00	–	9.00	–	15.00	–	–	–	–	17.21	1 : 5.30	1,065	1,065	0.00
Jan. 19 to Feb. 23, .	4.00	4.00	–	–	–	–	33.74	–	–	–	14.03	1 : 5.25	1,080	1,100	0.57
March 1 to March 23, .	4.00	4.00	–	–	–	–	–	47.45	–	–	14.70	1 : 5.62	1,115	1,145	1.36
March 29 to April 9, .	4.00	4.00	–	–	–	–	–	–	10.64	–	15.75	1 : 5.52	1,115	1,122	0.64
April 26 to May 16, .	4.00	–	4.00	10.00	–	–	–	–	–	15.00	18.48	1 : 5.83	1,160	1,178	0.90

	Pounds.
Live weight of animal at the beginning of the experiment, ...	926.00
Live weight of animal at the time of killing, ...	1,178.00
Live weight gained during the experiment, ...	252.00
Average gain in weight per day (entire experiment), ...	1.34
Highest average gain in live weight per day, I. period, ...	2.19
Lowest average gain in live weight per day, II. period, ...	0.00

Steer No. 3.

FEEDING PERIODS.	Feed consumed (Pounds) per Day.										Total Amount of Dry Matter consumed per Day (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
	Wheat Bran.	Maize Feed.	Gluten Feed.	Hay.	Turnips.	Globe Mangolds.	Dent Corn Ensilage.	Sweet Corn Ensilage.	Corn Stover.	Sugar Beets.					
1891-92.															
Nov. 10 to Dec. 22,	3.44	3.44	–	11.10	17.38	–	–	–	–	–	17.96	1 : 5.83	955	1,040	2.02
Dec. 29 to Jan. 13,	4.00	4.00	–	9.26	–	15.00	–	–	–	–	17.45	1 : 5.50	1,082	1,085	0.20
Jan. 19 to Feb. 23,	4.00	4.00	–	–	–	–	35.03	–	–	–	14.28	1 : 5.26	1,090	1,125	1.00
March 1 to March 23,	4.00	4.00	–	–	–	–	–	59.77	–	–	16.63	1 : 5.95	1,133	1,200	3.05
March 29 to April 9,	4.00	4.00	–	–	–	–	–	–	11.60	–	16.52	1 : 5.73	1,160	1,165	0.45
April 26 to May 16,	4.00	–	4.00	10.00	–	–	–	–	–	15.00	18.48	1 : 5.83	1,210	1,230	1.00

	Pounds.
Live weight of animal at the beginning of the experiment,	955.00
Live weight of animal at the time of killing,	1,230.00
Live weight gained during the experiment,	275.00
Average gain in weight per day (entire experiment),	1.46
Highest average gain in live weight per day, IV. period,	3.05
Lowest average gain in live weight per day, II. period,	0.20

III.

WINTER FEEDING EXPERIMENTS WITH LAMBS.

November, 1891, to May, 1892.

The experiment briefly described in a few succeeding pages is the third one of a series designed for the purpose of studying the feeding effect and general economy of different combinations of grain feed stuffs when fed in connection with the same or similar kinds of coarse fodder articles for the production of meat.

During our *first* experiment, corn meal, wheat bran and gluten meal (Chicago) furnished in varying proportions the grain feed part of the daily diet (see eighth annual report, pages 67–90). During the *second*, corn meal, wheat bran, old-process linseed meal and gluten meal (Chicago) served for that purpose (see ninth annual report, pages 128–147); while in the *third experiment*, which is here under discussion, *wheat bran*, *Buffalo gluten feed* and *Chicago maize feed* have been used as the grain feed part of the daily feed.

The coarse feed portion of the daily diet during the first and second experiments consisted exclusively of rowen (hay of the second cut of upland meadows) and of corn ensilage. In the third experiment during one feeding period corn ensilage was substituted by roots (globe mangolds). The selection of lambs in all these trials was confined to our local supply. From six to nine animals served in each case for our observations.

Six lambs, wethers, grades of uncertain parentage, were selected for the experiment here under consideration. Each animal occupied a separate pen during the entire time of observation; none of them were shorn before entering upon the trial.

1. *Live Weight and Cost of Lambs.*

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	Total.
Live weight (pounds), ...	74.00	68.50	67.25	73.50	65.00	77.75	426.00
Market cost at 5.5 cents per pound, .	$4 07	$3 77	$3 70	$4 04	$3 58	$4 28	$23 44

2. *Character and Cost of Fodder Articles.*

The grain feed used consisted of wheat bran, Chicago maize feed and Buffalo gluten feed bought in our local market. These articles were of a fair quality and of a good mechanical condition. *Chicago maize feed* and *Buffalo gluten feed* are waste products obtained from maize in connection with the manufacture of glucose-sugar; they are valuable recent additions to our commercial resources of concentrated feed stuffs. The coarse feed stuffs, consisting of rowen (hay of second cut of upland meadows), of corn ensilage and of globe mangolds, were produced at the station, and were of the same good quality as those described in a previous bulletin (No. 42). The local market value and the chemical composition of the various fodder articles used at different times in the daily diet are recorded in the subsequent tabular statements.

Local Market Cost per Ton of the Various Articles of Fodder used.

Wheat bran, ...	$22 00
Maize feed (Chicago), ...	25 00
Gluten feed (Buffalo), ...	23 00
Rowen, ...	15 00
Globe mangolds, ...	4 00
Dent corn ensilage, ...	2 50
Sweet corn ensilage, ...	2 50

Analyses of the Various Articles of Fodder used.

FOOD ANALYSES.	Wheat Bran.	Maize Feed.	Gluten Feed.	Rowen.	Globe Mangolds.	Dent Corn Ensilage.	Sweet Corn Ensilage.
Moisture at 100° C.,	10.01	8.70	8.97	13.90	87.75	79.92	84.30
Dry matter,	89.99	91.30	91.03	86.10	12.25	20.08	15.70
	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Analysis of Dry Matter.							
Crude ash,	6.58	0.78	0.77	8.28	9.06	4.99	6.32
" cellulose,	11.77	7.97	5.09	28.88	7.94	27.19	29.32
" fat,	5.04	7.37	13.46	3.91	0.88	3.29	7.36
" protein,	18.06	27.55	26.16	13.45	10.37	8.29	7.86
Non-nitrogenous extract matter,	58.55	56.33	54.52	45.48	71.75	56.24	49.14
	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Fertilizing Constituents.

[Nitrogen 15 cents, phosphoric acid 5½ cents, potassium oxide 4½ cents, per pound.]

FERTILIZER ANALYSES.	Wheat Bran.	Maize Feed.	Gluten Feed.	Rowen.	Globe Mangolds.	Dent Corn Ensilage.	Sweet Corn Ensilage.
Moisture,	10.01	8.70	8.97	13.90	87.75	79.92	84.30
Nitrogen,	2.60	4.03	3.81	1.853	0.203	0.27	0.20
Phosphoric acid,	2.85	0.70	0.69	0.464	0.093	0.14	0.089
Potassium oxide,	1.63	0.43	0.42	1.966	0.383	0.33	0.41
Valuation per 2,000 pounds,	$12 40	$13 25	$12 57	$7 84	$1 06	$1 26	$1 06

3. *Mode of Feeding.*

The grain feed portion of the daily diet consisted in every instance of *equal weights* of either wheat bran and Chicago maize feed or of wheat bran and Buffalo gluten feed. The amount of each used per head in the daily fodder ration varied in different feeding periods somewhat; during the earlier stages of the experiment it amounted to five ounces of each, per head, during later periods to six ounces. All animals received the same quantity at the same stage of the observation.

The daily coarse feed rations consisted either of rowen hay or of rowen hay with either corn ensilage or roots (globe mangolds). Whenever corn ensilage or roots were fed in common with rowen hay, only one-half of the customary daily rowen ration was given, while the consumption of corn ensilage or of the roots was governed by the appetite of each animal. One-half of the daily fodder ration — fine and coarser feed — was fed in the morning and the other half later in the afternoon. Water was given once a day, a few hours after feeding (mornings).

The entire experiment extended over a period of one hundred and eighty-three days, and was subdivided into five distinct feeding periods, varying in length from fourteen to thirty-five days, with five days between the periods.

Average Composition of the Daily Fodder Rations used during the Six Successive Feeding Periods.

I.		II.	
November 17 to December 1.		*December 5 to January 13.*	
Wheat bran (pounds),	0.34	Wheat bran (pounds),	0.33
Maize feed (pounds),	0.34	Maize feed (pounds),	0.33
Rowen (pounds),	1.37	Rowen (pounds),	0.68
Nutritive ratio,	1:4.84	Globe mangolds (pounds),	2.97
Total cost (cents),	1.83	Nutritive ratio,	1:5.12
Manurial value obtainable (cents),	0.89	Total cost (cents),	1.88
Net cost (cents),	0.94	Manurial value obtainable (cents),	0.78
		Net cost (cents),	1.10

III.		IV.	
January 17 to February 22.		*February 26 to March 23.*	
Wheat bran (pounds),	0.35	Wheat bran (pounds),	0.38
Maize feed (pounds),	0.35	Maize feed (pounds),	0.38
Rowen (pounds),	0.77	Rowen (pounds),	0.84
Dent corn ensilage (pounds),	1.97	Sweet corn ensilage (pounds),	2.68
Nutritive ratio,	1:5.26	Nutritive ratio,	1:5.34
Total cost (cents),	1.65	Total cost (cents),	1.86
Manurial value obtainable (cents),	0.80	Manurial value obtainable (cents),	0.88
Net cost (cents),	0.85	Net cost (cents),	0.98

Average Composition, etc. — Concluded.

V.		VI.	
March 27 to April 23.		*April 27 to May 18.*	
Wheat bran (pounds),	0.40	Wheat bran (pounds),	0.40
Maize feed (pounds),	0.40	Gluten feed (pounds),	0.40
Rowen (pounds),	1.40	Rowen (pounds),	1.37
Nutritive ratio,	1:4.79	Nutritive ratio,	1:5.02
Total cost (cents),	1.99	Total cost (cents),	1.93
Manurial value obtainable (cents),	0.98	Manurial value obtainable (cents),	0.95
Net cost (cents),	1.01	Net cost (cents),	0.98

Summary of Cost of the Above-stated Average Daily Fodder Rations used.

[Cents.]

	FEEDING PERIODS.					
	I.	II.	III.	IV.	V.	VI.
Total cost,	1.83	1.88	1.65	1.86	1.99	1.93
Manurial value obtainable,	0.89	0.78	0.80	0.88	0.98	0.95
Net cost,*	0.94	1.10	0.85	0.98	1.01	0.98

* Allowing ninety-two per cent. of the manurial value of the feed consumed obtainable.

4. *Gain in Live Weight during Experiment.*

[Pounds.]

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	Average.
Live weight at beginning of experiment,	74.00	68.50	67.25	73.50	65.00	77.75	71.00
Live weight at close of experiment,	97.00	85.50	87.50	85.00	75.00	98.50	88.08
Live weight gained during experiment,	23.00	17.00	20.25	11.50	10.00	20.75	17.07

The live weight of the lambs (six) engaged in our first experiment averaged, at the beginning of our experiments, 71 pounds; of those engaged in the second experiment (six) it averaged 53.5 pounds.

Yield of Dressed Weight.

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	Total.
Pounds of dressed weight, . . .	52.25	46.50	44.00	43.00	36.00	53.25	275.00
Returns at 11 cents per pound, . .	$5 75	$5 11	$4 84	$4 73	$3 96	$5 86	$30 25

Yield of Wool.

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	Total.
Pounds of wool, ...	6.50	5.25	5.75	5.25	6.25	5.75	34.75
Returns at 21 cents per pound, . .	$1 37	$1 10	$1 21	$1 10	$1 31	$1 21	$7 30

5. *Financial Results.*

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	Total.
Cost of lambs, ...	$4 11	$3 82	$3 75	$4 18	$3 73	$4 35	
Cost of feed consumed, . . .	3 67	3 38	3 41	3 53	2 75	3 54	
	$7 78	$7 20	$7 16	$7 71	$6 48	$7 89	$44 22
Value received for meat, . . .	$5 75	$5 11	$4 84	$4 73	$3 96	$5 86	
Value received for wool, . . .	1 37	1 10	1 21	1 10	1 31	1 21	
Value of obtainable manure, . .	1 73	1 59	1 60	1 67	1 28	1 66	
	$8 85	$7 70	$7 65	$7 50	$6 55	$8 73	$47 08

Conclusions.

1. The average daily increase in live weight as compared with that noticed in the two preceding experiments is not as satisfactory; lambs 4 and 5 fall not less than fifty per cent. behind, when compared with the gain obtained in case of lambs 1, 3 and 6.

2. The feeding effect of corn ensilage, when fed with the same kind and amount of grain feed, compares well with that of globe mangold roots.

3. The market cost of the daily fodder rations above stated is in the majority of cases lower than that of those used in our preceding experiments with lambs; it varies from 1.65 cents to 1.93 cents in different feeding periods.

4. The manurial value obtainable from the different daily fodder rations varies from 0.78 to 0.98 cents; it amounts to one-half of the market cost of the daily diet.

5. The temporary ruling low market cost of the grain feed during the third experiment, as compared with those on preceding occasions, and the high commercial value of the obtainable manurial refuse, due to their rich nitrogenous composition, have secured still a small profit over expenses charged where the rate of producing meat was too low to entitle to profit. In considering the stated financial results in all our feeding experiments, thus far published, it ought to be kept in mind that all our home-raised fodder articles are charged at a liberal local market price per ton.

Sheep No. 1.

FEEDING PERIODS.	Feed consumed (Pounds) per Day.							Total Amount of Dry Matter consumed per Day (Pounds).	Gain in Weight per Day (Pounds).	Pounds of Dry Matter produced One Pound Live Weight.	Nutritive Ratio.	Average Weight of Animal (Pounds).
	Wheat Bran.	Maize Feed.	Gluten Feed.	Rowen.	Globe Mangolds.	Dent Corn Ensilage.	Sweet Corn Ensilage.					
1891-92.												
Nov. 17 to Dec. 1, . . .	0.34	0.34	–	1.35	–	–	–	1.78	0.07	25.43	1 : 4.84	74.58
Dec. 5 to Jan. 13, . . .	0.33	0.33	–	0.68	3.00	–	–	1.55	0.28	5.54	1 : 5.12	78.87
Jan. 17 to Feb. 22, . . .	0.37	0.37	–	0.86	–	1.94	–	1.80	0.18	10.00	1 : 5.26	89.92
Feb. 26 to March 23, . . .	0.48	0.48	–	1.00	–	–	3.42	2.27	0.21	10.81	1 : 5.34	96.20
March 27 to April 23, . . .	0.50	0.50	–	1.35	–	–	–	2.07	0.13	15.92	1 : 4.78	98.38
April 27 to May 18, . . .	0.50	–	0.50	1.31	–	–	–	2.03	-0.29	–	1 : 5.00	100.37

Total Amount of Feed consumed from Nov. 17, 1891, to May 18, 1892.

	Dry Matter (Pounds).	Cost.	Manurial Value.
75.25 pounds wheat bran, ...	67.62	$0 83	$0 47
63.25 pounds maize feed, ...	57.75	0 79	0 42
12.00 pounds gluten feed, ...	10.92	0 14	0 08
189.50 pounds rowen, ...	163.15	1 42	0 74
128.00 pounds globe mangolds, . .	15.68	0 26	0 07
82.00 pounds dent corn ensilage, . .	16.47	0 10	0 05
101.00 pounds sweet corn ensilage,. .	15.87	0 13	0 05
	347.46	$3 67	$1 88

	Pounds.
Live weight of animal at the beginning of the experiment, .	74.00
Live weight of animal at the time of killing, ...	97.00
Live weight gained during the experiment, ...	23.00
Average gain in weight per day (entire experiment), . .	0.126
Dressed weight of animal, ...	52.25
Loss in weight by dressing, 46.13 per cent., or	44.75

Pounds of dry matter fed produced 1 pound of live weight, 15.11.

Cost of feed per pound of live weight gained, 15.96 cents.

Net cost of feed per pound gained after deducting 8 per cent. of manurial value, 8.43 cents.

Sheep No. 2.

FEEDING PERIODS.	Feed consumed (Pounds) per Day.							Total Amount of Dry Matter consumed per Day (Pounds).	Gain in Weight per Day (Pounds).	Pounds of Dry Matter produced One Pound Live Weight.	Nutritive Ratio.	Average Weight of Animal (Pounds).
	Wheat Bran.	Maize Feed.	Gluten Feed.	Rowen.	Globe Mangolds.	Dent Corn Ensilage.	Sweet Corn Ensilage.					
1891-92.												
Nov. 17 to Dec. 1,	0.34	0.34	–	1.35	–	–	–	1.78	0.21	8.48	1 : 4.84	70.33
Dec. 5 to Jan. 13,	0.33	0.33	–	0.63	2.79	–	–	1.48	0.18	8.22	1 : 5.10	73.17
Jan. 17 to Feb. 22,	0.37	0.37	–	0.89	–	1.85	–	1.81	0.14	12.95	1 : 5.26	82.67
Feb. 26 to March 23,	0.37	0.37	–	0.85	–	–	2.00	1.71	0.13	13.15	1 : 5.33	85.56
March 27 to April 23,	0.37	0.37	–	1.46	–	–	–	1.93	0.13	14.85	1 : 4.79	88.50
April 27 to May 18,	0.37	–	0.37	1.45	–	–	–	1.92	–0.25	–	1 : 5.04	89.31

Total Amount of Feed consumed from Nov. 17, 1891, to May 18, 1892.

	Dry Matter (Pounds).	Cost.	Manurial Value.
65.62 pounds wheat bran,	59.05	$0 72	$0 41
56.62 pounds maize feed,	51.69	0 71	0 37
9.00 pounds gluten feed,	8.19	0 10	0 06
190.50 pounds rowen,	164.02	1 43	0 75
120.00 pounds globe mangolds,	14.70	0 24	0 06
78.50 pounds dent corn ensilage,	15.76	0 10	0 05
65.00 pounds sweet corn ensilage,	10.21	0 08	0 03
	323.62	$3 38	$1 73

	Pounds.
Live weight of animal at the beginning of the experiment,	68.50
Live weight of animal at the time of killing,	85.50
Live weight gained during the experiment,	17.00
Average gain in weight per day (entire experiment),	0.093
Dressed weight of animal,	46.50
Loss in weight by dressing, 45.61 per cent., or	39.00

Pounds of dry matter fed produced 1 pound of live weight, 19.04.

Cost of feed per pound of live weight gained, 19.88 cents.

Net cost of feed per pound gained after deducting 8 per cent. of manurial value, 10.53 cents.

Sheep No. 3.

FEEDING PERIODS.	Feed consumed (Pounds) per Day.							Total Amount of Dry Matter consumed per Day (Pounds).	Gain in Weight per Day (Pounds).	Pounds of Dry Matter produced One Pound Live Weight.	Nutritive Ratio.	Average Weight of Animal (Pounds).
	Wheat Bran.	Maize Feed.	Gluten Feed.	Rowen.	Globe Mangolds.	Dent Corn Ensilage.	Sweet Corn Ensilage.					
1891-92.												
Nov. 17 to Dec. 1, . . .	0.31	0.31	–	1.25	–	–	–	1.64	0.23	7.13	1:4.84	69.25
Dec. 5 to Jan. 13, . . .	0.37	0.37	–	0.83	3.00	–	–	1.75	0.22	7.95	1:5.12	74.42
Jan. 17 to Feb. 22, . . .	0.37	0.37	–	0.81	–	1.51	–	1.67	0.10	16.70	1:5.25	80.90
Feb. 26 to March 23, . . .	0.37	0.37	–	0.94	–	–	1.96	1.79	0.08	22.38	1:5.33	84.12
March 27 to April 23, . . .	0.37	0.37	–	1.39	–	–	–	1.87	0.03	62.33	1:4.78	86.87
April 27 to May 18, . . .	0.37	–	0.37	1.21	–	–	–	1.71	0.13	13.15	1:5.02	87.81

Total Amount of Feed consumed from Nov. 17, 1891, to May 18, 1892.

	Dry Matter (Pounds).	Cost.	Manurial Value.
67.00 pounds wheat bran,	60.29	$0 74	$0 42
58.00 pounds maize feed,	52.95	0 73	0 38
9.00 pounds gluten feed,	8.19	0 10	0 06
189.50 pounds rowen,	163.15	1 42	0 74
128.00 pounds globe mangolds,	15.68	0 26	0 07
66.50 pounds dent corn ensilage,	13.35	0 08	0 04
63.00 pounds sweet corn ensilage,	9.89	0 08	0 03
	323.50	$3 41	$1 74

	Pounds.
Live weight of animal at the beginning of the experiment,	67.25
Live weight of animal at the time of killing,	87.50
Live weight gained during the experiment,	20.25
Average gain in weight per day (entire experiment),	0.110
Dressed weight of animal,	44.00
Loss in weight by dressing, 49.71 per cent., or	43.50

Pounds of dry matter fed produced 1 pound of live weight, 15.97.

Cost of feed per pound of live weight gained, 16.84 cents.

Net cost of feed per pound gained after deducting 8 per cent. of manurial value, 8.93.

Sheep No. 4.

FEEDING PERIODS.	FEED CONSUMED (POUNDS) PER DAY.							Total Amount of Dry Matter consumed per Day (Pounds).	Gain in Weight per Day (Pounds).	Pounds of Dry Matter produced One Pound Live Weight.	Nutritive Ratio.	Average Weight of Animal (Pounds).
	Wheat Bran.	Maize Feed.	Gluten Feed.	Rowen.	Globe Mangolds.	Dent Corn Ensilage.	Sweet Corn Ensilage.					
1891-92.												
Nov. 17 to Dec. 1, . . .	0.33	0.33	–	1.32	–	–	–	1.73	0.11	15.73	1:4.84	74.08
Dec. 5 to Jan. 13, . . .	0.37	0.37	–	0.80	3.00	–	–	1.72	0.18	9.56	1:5.12	79.33
Jan. 17 to Feb. 22, . . .	0.37	0.37	–	1.00	–	2.00	–	1.93	0.05	38.60	1:5.26	84.70
Feb. 26 to March 23, . . .	0.37	0.37	–	1.00	–	–	2.61	1.94	0.13	14.92	1:5.36	86.75
March 27 to April 23, . . .	0.37	0.37	–	1.39	–	–	–	1.87	0.06	31.17	1:4.78	89.87
April 27 to May 18, . . .	0.37	–	0.37	1.43	–	–	–	1.90	–0.22	–	1:5.04	89.19

Total Amount of Feed consumed from Nov. 17, 1891, to May 18, 1892.

	Dry Matter (Pounds).	Cost.	Manurial Value.
67.50 pounds wheat bran,	60.74	$0 74	$0 42
58.50 pounds maize feed,	53.41	0 73	0 39
9.00 pounds gluten feed,	8.19	0 10	0 06
198.50 pounds rowen,	160.91	1 49	0 78
128.00 pounds globe mangolds,	15.68	0 26	0 07
84.00 pounds dent corn ensilage,	16.87	0 11	0 05
80.00 pounds sweet corn ensilage,	12.56	0 10	0 04
	328.36	$3 53	$1 81

	Pounds.
Live weight of animal at the beginning of the experiment,	73.50
Live weight of animal at the time of killing,	85.00
Live weight gained during the experiment,	11.50
Average gain in weight per day (entire experiment),	0.063
Dressed weight of animal,	43.00
Loss in weight by dressing, 49.41 per cent., or	42.00

Pounds of dry matter fed produced 1 pound of live weight, 28.55.

Cost of feed per pound of live weight gained, 30.70 cents.

Net cost of feed per pound gained after deducting 8 per cent. of manurial value, 16.17 cents.

Sheep No. 5.

FEEDING PERIODS.	FEED CONSUMED (POUNDS) PER DAY.							Total Amount of Dry Matter consumed per Day (Pounds).	Gain in Weight per Day (Pounds).	Pounds of Dry Matter produced One Pound Live Weight.	Nutritive Ratio.	Average Weight of Animal (Pounds).
	Wheat Bran.	Maize Feed.	Gluten Feed.	Rowen.	Globe Mangolds.	Dent Corn Ensilage.	Sweet Corn Ensilage.					
1891-92.												
Nov. 17 to Dec. 1, . . .	0.31	0.31	–	1.23	–	–	–	1.62	0.02	81.00	1:4.84	64.67
Dec. 5 to Jan. 13, . . .	0.27	0.27	–	0.33	3.00	–	–	1.14	0.15	7.60	1:5.12	68.79
Jan. 17 to Feb. 22, . . .	0.25	0.25	–	0.39	–	2.00	–	1.19	0.06	19.83	1:5.24	73.95
Feb. 26 to March 23, . . .	0.26	0.26	–	0.56	–	–	2.42	1.33	0.04	33.25	1:5.30	76.37
March 27 to April 23, . . .	0.31	0.31	–	1.44	–	–	–	1.80	-0.20	–	1:4.85	76.62
April 27 to May 18, . . .	0.31	–	0.31	1.48	–	–	–	1.84	0.39	4.72	1:5.10	74.17

Total Amount of Feed consumed from Nov. 17, 1891, to May 18, 1892.

	Dry Matter (Pounds).	Cost.	Manurial Value.
51.50 pounds wheat bran,	46.34	$0 57	$0 32
44.00 pounds maize feed,	40.17	0 55	0 29
7.50 pounds gluten feed,	6.83	0 09	0 05
144.25 pounds rowen,	124.20	1 08	0 57
128.00 pounds globe mangolds,	15.68	0 26	0 07
84.50 pounds dent corn ensilage,	16.97	0 11	0 05
75.00 pounds sweet corn ensilage,	11.78	0 09	0 04
	261.97	$2 75	$1 39

	Pounds.
Live weight of animal at the beginning of the experiment,	65.00
Live weight of animal at the time of killing,	75.00
Live weight gained during the experiment,	10.00
Average gain in weight per day (entire experiment),	0.054
Dressed weight of animal,	36.00
Loss in weight by dressing, 52.00 per cent., or	39.00

Pounds of dry matter fed produced 1 pound of live weight, 26.20.

Cost of feed per pound of live weight gained, 27.50 cents.

Net cost of feed per pound gained after deducting 8 per cent. of manurial value, 14.70 cents.

Sheep No. 6.

Feeding Periods.	Feed consumed (Pounds) per Day.							Total Amount of Dry Matter consumed per Day (Pounds).	Gain in Weight per Day (Pounds).	Pounds of Dry Matter produced One Pound Live Weight.	Nutritive Ratio.	Average Weight of Animal (Pounds).
	Wheat Bran.	Maize Feed.	Gluten Feed.	Rowen.	Globe Mangolds.	Dent Corn Ensilage.	Sweet Corn Ensilage.					
1891-92.												
Nov. 17 to Dec. 1, . . .	0.42	0.42	-	1.70	-	-	-	2.22	0.16	13.88	1 : 4.84	79.33
Dec. 5 to Jan. 13, . . .	0.32	0.32	-	0.79	3.00	-	-	1.63	0.16	10.19	1 : 5.14	83.12
Jan. 17 to Feb. 22, . . .	0.35	0.35	-	0.64	-	2.51	-	1.69	0.10	16.90	1 : 5.27	91.35
Feb. 26 to March 23, . . .	0.40	0.40	-	0.69	-	-	3.69	1.90	0.17	11.18	1 : 5.38	97.19
March 27 to April 23, . . .	0.50	0.50	-	1.39	-	-	-	2.10	0.23	9.13	1 : 4.78	101.62
April 27 to May 18, . . .	0.50	-	0.50	1.36	-	-	-	2.07	-0.34	-	1 : 5.00	103.50

Total Amount of Feed consumed from Nov. 17, 1891, to May 18, 1892.

	Dry Matter (Pounds).	Cost.	Manurial Value.
73.12 pounds wheat bran,	65.79	$0 80	$0 45
61.12 pounds maize feed,	55.80	0 76	0 40
12.00 pounds gluten feed,	10.92	0 14	0 08
174.50 pounds rowen,	150.24	1 31	0 68
128.00 pounds globe mangolds,	15.68	0 26	0 07
102.50 pounds dent corn ensilage,	20.58	0 13	0 06
108.00 pounds sweet corn ensilage,	16.96	0 14	0 06
	335.97	$3 54	$1 80

	Pounds.
Live weight of animal at the beginning of the experiment,	77.75
Live weight of animal at the time of killing,	98.50
Live weight gained during the experiment,	20.75
Average gain in weight per day (entire experiment),	0.113
Dressed weight of animal,	53.25
Loss in weight by dressing, 45.94 per cent., or	45.25

Pounds of dry matter fed produced 1 pound live weight, 16.19.

Cost of feed per pound of live weight gained, 17.06 cents.

Net cost of feed per pound gained after deducting 8 per cent. of manurial value, 9.06 cents.

IV.

FEEDING EXPERIMENTS WITH PIGS (TWO).

1891–92.

Introduction. — The results of fifteen different feeding experiments with young pigs, grades and thoroughbreds, for the meat market, have already been published in our preceding annual reports. The results of two new experiments are reported on the present occasion.

We usually keep, the whole year around, one young pig for every cow in the dairy, to dispose of our skim-milk. On the average, five lots of young pigs are prepared for the meat market every two years. The animals are usually bought when from five to six weeks old, and weigh from 25 to 30 pounds per head. They are fed until they reach a live weight of from 180 to 190 pounds, when they are sold to the butcher.

From 112 to 125 days are usually required to produce the desired live weight. Their daily gain in live weight has been from 1.4 to 1.5 pounds. During spring, summer and autumn one to two weeks less time is needed than during the winter season to finish the operation. The shrinkage from live weight to dressed weight varies usually from 18 to 21 per cent.

Our daily supply of skim-milk rarely exceeds five quarts per head of young pigs. We usually begin feeding from two to three ounces of corn meal with every quart of skim-milk required at the time. As soon as the live weight has reached from 60 to 70 pounds per head we increase the corn meal to four ounces per quart of skim-milk consumed.

The additional feed subsequently called for has usually been made of either a suitable mixture of several kinds of commercial feed stuffs, as wheat bran and Chicago gluten meal, or dried brewers' grain and gluten meal, or ground barley and Chicago maize feed; or some single feed stuff, as Buffalo gluten feed or Chicago maize feed. The market cost of the various feed stuffs suitable for the purpose largely controls, for obvious reasons, their temporary selection.

During the present year (1892) Chicago maize feed and Buffalo gluten feed have been chosen for our observation. The market cost of the feed consumed per pound of dressed pork produced has varied during past years from 4.3 to 6.4 cents.

The available manurial refuse has amounted to two-fifths of the market cost of the feed consumed. Dressed pork has of late sold at from 6½ to 7½ cents per pound. Allowing 20 per cent. of shrinkage —

7.25 cents per pound of dressed weight is equal to 5.8 cents per pound live weight.
6.50 cents per pound of dressed weight is equal to 5.2 cents per pound live weight.
6.00 cents per pound of dressed weight is equal to 4.8 cents per pound live weight.

SIXTEENTH FEEDING EXPERIMENT WITH PIGS.

September, 1891, to February, 1892.

Six pigs, grade Chester Whites, were purchased on Sept. 12, 1891, at $2.50 apiece. Three were sows and three barrows. For a period of about nine weeks preceding the experiment proper the pigs were fed on skim-milk and potatoes. The potatoes were boiled and mashed with the milk. The figures below are for the entire six pigs, no individual records having been kept of this period.

Total Amount of Feed consumed from Sept. 22, 1891, to Nov. 28, 1891.

	Cost.	Manurial Value.
1,875.00 quarts skim-milk, ...	$8 44	$3 97
1,752.00 pounds potatoes, ...	5 25*	0 84
	$13 69	$4 81

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* At 15 cents per bushel, small, and not suitable for family use.

	Pounds.
Total live weight of the six pigs September 22,	244.00
Total live weight of the six pigs November 28,	520.50
Total live weight gained,	276.50
Average gain in weight per day (entire period),	4.13
Average daily gain per pig,	0.69

Total cost of feed per pound of live weight gained, 4.95 cents.

Net cost of feed per pound gained after deducting 30 per cent. of manurial value, 3.73 cents.

Local Market Cost of the Various Articles of Fodder used.

Barley meal, per ton,	$30 00
Skim-milk, per gallon,	0 018
Wheat bran, per ton,	22 00
Maize feed (Chicago), per ton,	25 00

Analyses of the Various Articles of Fodder used.

Food Analyses.	Barley Meal.	Skim-milk.	Wheat Bran.	Maize Feed.
Moisture at 100° C.,	12.90	89.78	10.01	8.70
Dry matter,	87.10	10.22	89.99	91.30
	100.00	100.00	100.00	100.00
Analysis of Dry Matter.				
Crude ash,	2.30	6.85	6.58	0.78
" cellulose,	7.11	–	11.77	7.97
" fat,	1.94	3.82	5.04	7.37
" protein,	10.80	31.60	18.06	27.55
Non-nitrogenous extract matter,	77.85	57.73	58.55	56.33
	100.00	100.00	100.00	100.00

Fertilizing Constituents.

[Nitrogen 15 cents, phosphoric acid 5½ cents, potassium oxide 4½ cents, per pound.]

Fertilizer Analyses.	Barley Meal.	Skim-milk.*	Wheat Bran.	Maize Feed.
Moisture,	12.90	89.78	10.01	8.70
Nitrogen,	1.507	0.52	2.60	4.03
Phosphoric acid,	0.664	0.19	2.85	0.70
Potassium oxide,	0.342	0.20	1.63	0.43
Valuation per 2,000 pounds,	$5 56	$1 95	$12 40	$13 25

* One quart equals 2.17 pounds.

Conclusions.

1. The entire lot of young pigs (six), weighing on an average 40 pounds per head, gained in 69 days, when fed in one pen together on boiled potatoes and skim-milk (one pound of potatoes to every quart of milk consumed), 46 pounds in live weight per head, or 0.69 pounds per day, at an average cost of 4.95 cents per pound of live weight gained.

2. The same lot of pigs, when subsequently isolated in six different pens and fed on a daily diet consisting, as previously specified, of skim-milk, barley meal, wheat bran and Chicago maize feed, gained on an average in 65 days 95.5 pounds each, or 1.49 pounds per day, at an average total cost of 5.64 cents per pound of live weight, or 4.8 cents of net cost.

3. The high cost of feed per pound of live weight gained in this experiment is due to two causes, namely, low rate of daily increase in live weight during the first half of the time occupied by the experiment, and to the high market cost of the ground barley used in large quantities during the second half of the experiment.

Pig No. 1.

FEEDING PERIOD.	Total Amount of Barley Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Maize Feed consumed (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
1891-92. Dec. 1 to Feb. 3, . .	169.37	344.00	77.06	77.06	1:4.07	71.00	171.00	1.56

Total Amount of Feed consumed from Dec. 1, 1891, to Feb. 3, 1892.

	Dry Matter (Pounds).	Cost.	Manurial Value.
169.37 pounds barley meal, . .	147.52	$2 54	$0 47
344.00 quarts skim-milk, . . .	76.29	1 55	0 73
77.06 pounds wheat bran, . .	69.35	0 85	0 48
77.06 pounds maize feed, . .	70.36	0 96	0 51
	363.52	$5 90	$2 19

	Pounds.
Live weight of animal at the beginning of the experiment, .	71.00
Live weight of animal at the time of killing, ...	171.00
Live weight gained during the experiment, ...	100.00
Dressed weight of animal, ...	131.50
Loss in weight by dressing, 23.10 per cent., or	39.50
Dressed weight gained during the experiment, ...	76.90

Pounds of dry matter fed produced 1 pound of live weight, 3.64.

Pounds of dry matter fed produced 1 pound of dressed weight, 4.73.

Cost of feed per pound of dressed weight gained, 7.67 cents.

Net cost of feed per pound of dressed weight gained after deducting 30 per cent. of the manurial value, 5.69 cents.

Pig No. 2.

Feeding Period.	Total Amount of Barley Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Maize Feed consumed (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
1891-92. Dec. 1 to Feb. 3,	172.00	344.00	94.03	94.03	1:4.03	94.00	194.00	1.56

Total Amount of Feed consumed from Dec. 1, 1891, to Feb. 3, 1892.

	Dry Matter (Pounds).	Cost.	Manurial Value.
172.00 pounds barley meal,	149.81	$2 58	$0 48
344.00 quarts skim-milk,	76.29	1 55	0 73
94.03 pounds wheat bran,	84.62	1 03	0 58
94.03 pounds maize feed,	85.85	1 18	0 62
	396.57	$6 34	$2 41

	Pounds.
Live weight of animal at the beginning of the experiment,	94.00
Live weight of animal at the time of killing,	194.00
Live weight gained during the experiment,	100.00
Dressed weight of animal,	149.00
Loss in weight by dressing, 23.20 per cent., or	45.00
Dressed weight gained during the experiment,	76.80

Pounds of dry matter fed produced 1 pound of live weight, 3.97.

Pounds of dry matter fed produced 1 pound of dressed weight, 5.16.

Cost of feed per pound of dressed weight gained, 8.25 cents.

Net cost of feed per pound of dressed weight gained after deducting 30 per cent. of the manurial value, 6.05 cents.

Pig No. 3.

FEEDING PERIOD.	Total Amount of Barley Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Maize Feed consumed (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
1891-92. Dec. 1 to Feb. 3,	172.00	344.00	90.66	90.66	1:4.06	99.50	192.50	1.45

Total Amount of Feed consumed from Dec. 1, 1891, to Feb. 3, 1892.

	Dry Matter (Pounds).	Cost.	Manurial Value.
172.00 pounds barley meal,	149.81	$2 58	$0 48
344.00 quarts skim-milk,	76.29	1 55	0 73
90.66 pounds wheat bran,	81.58	1 00	0 56
90.66 pounds maize feed,	82.77	1 13	0 60
	390.45	$6 26	$2 37

	Pounds.
Live weight of animal at the beginning of the experiment,	99.50
Live weight of animal at the time of killing,	192.50
Live weight gained during the experiment,	93.00
Dressed weight of animal,	146.50
Loss in weight by dressing, 23.90 per cent., or	46.00
Dressed weight gained during the experiment,	70.77

Pounds of dry matter fed produced 1 pound of live weight, 4.20.

Pounds of dry matter fed produced 1 pound of dressed weight, 5.52.

Cost of feed per pound of dressed weight gained, 8.84 cents.

Net cost of feed per pound of dressed weight gained after deducting 30 per cent. of the manurial value, 6.50 cents.

Pig No. 4.

FEEDING PERIOD.	Total Amount of Barley Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Maize Feed consumed (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
1891-92. Dec. 1 to Feb. 3, . .	172.00	344.00	80.34	80.34	1:4.08	92.75	185.00	1.44

Total Amount of Feed consumed from Dec. 1, 1891, to Feb. 3, 1892.

	Dry Matter (Pounds).	Cost.	Manurial Value.
172.00 pounds barley meal, . .	149.81	$2 58	$0 48
344.00 quarts skim-milk, . . .	76.29	1 55	0 73
80.34 pounds wheat bran, . .	72.30	0 88	0 50
80.34 pounds maize feed, . .	73.35	1 00	0 53
	371.75	$6 01	$2 24

	Pounds.
Live weight of animal at the beginning of the experiment, .	92.75
Live weight of animal at the time of killing, ...	185.00
Live weight gained during the experiment, ...	92.25
Dressed weight of animal, ...	151.00
Loss in weight by dressing, 18.38 per cent., or	34.00
Dressed weight gained during the experiment, ...	75.29

Pounds of dry matter fed produced 1 pound of live weight, 4.03.

Pounds of dry matter fed produced 1 pound of dressed weight, 4.94.

Cost of feed per pound of dressed weight gained, 7.98 cents.

Net cost of feed per pound of dressed weight gained after deducting 30 per cent. of the manurial value, 5.90 cents.

Pig No. 5.

FEEDING PERIOD.	Total Amount of Barley Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Maize Feed consumed (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
1891-92. Dec. 1 to Feb. 3, . .	172.00	344.00	90.47	90.47	1:4.06	92.50	192.00	1.55

Total Amount of Feed consumed from Dec. 1, 1891, to Feb. 3, 1892.

	Dry Matter (Pounds).	Cost.	Manurial Value.
172.00 pounds barley meal, . .	149.81	$2 58	$0 48
344.00 quarts skim-milk, . . .	76.29	1 55	0 73
90.47 pounds wheat bran, . .	81.41	1 00	0 56
90.47 pounds maize feed, . .	82.60	1 13	0 60
	390.11	$6 26	$2 37

	Pounds.
Live weight of animal at the beginning of the experiment, .	92.50
Live weight of animal at the time of killing, ...	192.00
Live weight gained during the experiment, ...	99.50
Dressed weight of animal, ...	142.00
Loss in weight by dressing, 26.04 per cent., or	50.00
Dressed weight gained during the experiment, ...	73.59

Pounds of dry matter fed produced 1 pound of live weight, 3.92.

Pounds of dry matter fed produced 1 pound of dressed weight, 5.30.

Cost of feed per pound of dressed weight gained, 8.51 cents.

Net cost of feed per pound of dressed weight gained after deducting 30 per cent. of the manurial value, 6.25 cents.

Pig No. 6.

Feeding Period.	Total Amount of Barley Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Maize Feed consumed (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
1891-92. Dec. 1 to Feb. 3, . .	172.00	344.00	82.59	82.59	1:4.08	91.50	180.00	1.38

Total Amount of Feed consumed from Dec. 1, 1891, to Feb. 3, 1892.

	Dry Matter (Pounds).	Cost.	Manurial Value.
172.00 pounds barley meal, . .	149.80	$2 58	$0 48
344.00 quarts skim-milk, . . .	76.29	1 55	0 73
82.59 pounds wheat bran, . .	74.32	0 91	0 51
82.59 pounds maize feed, . .	75.40	1 03	0 55
	375.81	$6 07	$2 27

	Pounds.
Live weight of animal at the beginning of the experiment, .	91.50
Live weight of animal at the time of killing, ...	180.00
Live weight gained during the experiment, ...	88.50
Dressed weight of animal, ...	147.00
Loss in weight by dressing, 18.33 per cent., or	33.00
Dressed weight gained during the experiment, ...	72.28

Pounds of dry matter fed produced 1 pound of live weight, 4.25.

Pounds of dry matter fed produced 1 pound of dressed weight, 5.20.

Cost of feed per pound of dressed weight gained, 8.40 cents.

Net cost of feed per pound of dressed weight gained after deducting 30 per cent. of the manurial value, 6.20 cents.

SEVENTEENTH FEEDING EXPERIMENT WITH PIGS.

March, 1892, to July, 1892.

Six pigs, grade Chester Whites, were purchased on Feb. 23, 1892, at $3.00 a piece. No. 2 and No. 3 were barrows and the rest were sows.

Local Market Cost of the Various Articles of Fodder used.

Corn meal, per ton,	$24 00
Skim-milk, per gallon,	0 018
Gluten feed (Buffalo), per ton,	23 00

The mode of feeding, as well as the general management of the experiment, has been the same as on previous occasions of a corresponding character.

Analyses of the Various Articles of Fodder used.

FOOD ANALYSES.	Corn Meal.	Skim-milk.	Gluten Feed.
Moisture at 100° C.,	13.96	89.78	8.97
Dry matter,	86.04	10.22	91.03
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	1.26	6.85	0.77
" cellulose,	1.49	–	5.09
" fat,	3.97	3.82	13.46
" protein,	11.11	31.60	26.16
Non-nitrogenous extract matter,	82.17	57.73	54.52
	100.00	100.00	100.00

Fertilizing Constituents.

[Nitrogen 15 cents, phosphoric acid 5½ cents, potassium oxide 4½ cents, per pound.]

FERTILIZER ANALYSES.	Corn Meal.	Skim-milk.*	Gluten Feed.
Moisture,	13.96	89.78	8.97
Nitrogen,	1.529	0.52	3.81
Phosphoric acid,	0.707	0.19	0.69
Potassium oxide,	0.435	0.20	0.42
Valuation per 2,000 pounds,	$5 76	$1 95	$12 57

* One quart equals 2.17 pounds.

Conclusions.

1. The average weight of the young pigs at the beginning of the experiment was 33 pounds per head, and their average weight at the close of the experiment was 191 pounds per head.

2. The experiment extended over 122 days. The daily gain in live weight averaged per head 1.56 pounds.

3. The total cost of feed consumed per pound of dressed weight produced averaged 5.8 cents, while the net cost averaged 4.2 cents. The obtainable manurial refuse amounted to two-fifths of the market cost of the diet consumed.

4. The dressed pork sold in our local markets at 6½ cents per pound.

Pig No. 1.

FEEDING PERIODS.	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Gluten Feed consumed (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
1892.							
March 23 to May 10, ...	34.12	273.00	–	1:3.10	35.00	71.50	0.76
May 10 to June 21, ...	63.00	252.00	54.37	1:3.88	71.50	130.50	1.40
June 21 to July 28, ...	119.81	222.00	36.56	1:4.69	130.50	184.50	1.46

Total Amount of Feed consumed from March 23, 1892, to July 28, 1892.

	Dry Matter (Pounds).	Cost.	Manurial Value.
216.93 pounds corn meal, . . .	186.65	$2 60	$0 62
747.00 quarts skim-milk, . . .	76.34	3 36	1 58
90.93 pounds gluten feed, . .	82.77	1 05	0 57
	345.76	$7 01	$2 77

	Pounds.
Live weight of animal at the beginning of the experiment, .	35.00
Live weight of animal at the time of killing, ...	184.50
Live weight gained during the experiment, ...	149.50
Dressed weight of animal, ...	154.00
Loss in weight by dressing, 16.53 per cent., or	30.50
Dressed weight gained during the experiment, ...	124.79

Pounds of dry matter fed produced 1 pound of live weight, 2.31.

Pounds of dry matter fed produced 1 pound of dressed weight, 2.77.

Cost of feed per pound of dressed weight gained, 5.62 cents.

Net cost of feed per pound of dressed weight gained after deducting 30 per cent. of manurial value, 4.06 cents.

Pig No. 2.

FEEDING PERIODS.	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Gluten Feed consumed (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
1892.							
March 23 to May 10, ...	34.12	273.00	-	1:3.10	33.00	72.50	0.82
May 10 to June 21, ...	63.00	252.00	55.12	1:3.88	72.50	133.50	1.45
June 21 to July 28, ...	128.44	222.00	45.19	1:4.75	133.50	197.00	1.72

Total Amount of Feed consumed from March 23, 1892, to July 28, 1892.

	Dry Matter (Pounds).	Cost.	Manurial Value.
225.56 pounds corn meal, . . .	194.07	$2 71	$0 65
747.00 quarts skim-milk, . . .	76.34	3 36	1 58
100.31 pounds gluten feed, . .	91.31	1 15	0 63
	361.72	$7 22	$2 86

	Pounds.
Live weight of animal at the beginning of the experiment, .	33.00
Live weight of animal at the time of killing, ...	197.00
Live weight gained during the experiment, ...	164.00
Dressed weight of animal, ...	144.00
Loss in weight by dressing, 26.90 per cent., or	53.00
Dressed weight gained during the experiment, ...	119.88

Pounds of dry matter fed produced 1 pound of live weight, 2.21.

Pounds of dry matter fed produced 1 pound of dressed weight, 3.02.

Cost of feed per pound of dressed weight gained, 6.02 cents.

Net cost of feed per pound of dressed weight gained after deducting 30 per cent. of manurial value, 4.35 cents.

Pig No. 3.

FEEDING PERIODS.	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Gluten Feed consumed (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
1892.							
March 23 to May 10,	34.12	273.00	-	1:3.10	34.50	71.50	0.77
May 10 to June 21,	63.00	252.00	52.87	1:3.88	71.50	125.50	1.29
June 21 to July 28,	128.37	222.00	45.12	1:4.75	125.50	196.50	1.91

Total Amount of Feed consumed from March 23, 1892, to July 28, 1892.

	Dry Matter (Pounds).	Cost.	Manurial Value.
229.47 pounds corn meal,	197.44	$2 75	$0 66
747.00 quarts skim-milk,	76.34	3 36	1 58
97.99 pounds gluten feed,	89.20	1 12	0 61
	362.98	$7 23	$2 85

	Pounds.
Live weight of animal at the beginning of the experiment,	34.50
Live weight of animal at the time of killing,	196.00
Live weight gained during the experiment,	161.50
Dressed weight of animal,	148.00
Loss in weight by dressing, 24.49 per cent., or	48.00
Dressed weight gained during the experiment,	121.95

Pounds of dry matter fed produced 1 pound of live weight, 2.25.

Pounds of dry matter fed produced 1 pound of dressed weight, 2.98.

Cost of feed per pound of dressed weight gained, 5.93 cents.

Net cost of feed per pound of dressed weight gained after deducting 30 per cent. of manurial value, 4.29 cents.

Pig No. 4.

FEEDING PERIODS.	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Gluten Feed consumed (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
1892.							
March 23 to May 10, . . .	34.12	273.00	–	1:3.10	33.00	73.75	0.85
May 10 to June 21, . . .	63.00	252.00	55.12	1:3.88	73.75	133.50	1.42
June 21 to July 28, . . .	122.62	222.00	39.37	1:4.72	133.50	192.50	1.59

Total Amount of Feed consumed from March 23, 1892, to July 28, 1892.

	Dry Matter (Pounds).	Cost.	Manurial Value.
219.74 pounds corn meal, . . .	189.06	$2 64	$0 63
747.00 quarts skim-milk, . . .	76.34	3 36	1 58
94.49 pounds gluten meal, . .	86.01	1 08	0 59
	351.41	$7 08	$2 80

	Pounds.
Live weight of animal at the beginning of the experiment, .	33.00
Live weight of animal at the time of killing, ...	192.50
Live weight gained during the experiment, ...	159.50
Dressed weight of animal, ...	148.00
Loss in weight by dressing, 23.12 per cent., or	44.50
Dressed weight gained during the experiment, ...	122.62

Pounds of dry matter fed produced 1 pound of live weight, 2.20.

Pounds of dry matter fed produced 1 pound of dressed weight, 2.87.

Cost of feed per pound of dressed weight gained, 5.77 cents.

Net cost of feed per pound of dressed weight gained after deducting 30 per cent. of manurial value, 4.18 cents.

Pig No. 5.

Feeding Periods.	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Gluten Feed consumed (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
1892.							
March 23 to May 10,	34.12	273.00	–	1:3.10	30.00	70.25	0.84
May 10 to June 21,	63.00	252.00	39.37	1:3.88	70.25	120.00	1.18
June 21 to July 28,	124.62	222.00	41.37	1:4.73	120.00	183.25	1.71

Total Amount of Feed consumed from March 23, 1892, to July 28, 1892.

	Dry Matter (Pounds).	Cost.	Manurial Value.
221.74 pounds corn meal,	190.79	$2 66	$0 64
747.00 quarts skim-milk,	76.34	3 36	1 58
80.74 pounds gluten meal,	73.50	0 93	0 51
	340.63	$6 95	$2 73

	Pounds.
Live weight of animal at the beginning of the experiment,	30.00
Live weight of animal at the time of killing,	183.25
Live weight gained during the experiment,	153.25
Dressed weight of animal,	144.00
Loss in weight by dressing, 21.42 per cent., or	39.25
Dressed weight gained during the experiment,	120.42

Pounds of dry matter fed produced 1 pound of live weight, 2.22.

Pounds of dry matter fed produced 1 pound of dressed weight, 2.91.

Cost of feed per pound of dressed weight gained, 5.77 cents.

Net cost of feed per pound of dressed weight gained after deducting 30 per cent. of manurial value, 4.18 cents.

Pig No. 6.

FEEDING PERIODS.	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Gluten Feed consumed (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
1892.							
March 23 to May 10, . . .	34.12	273.00	–	1:3.10	35.00	79.50	0.93
May 10 to June 21, . . .	63.00	252.00	43.50	1:3.88	79.50	143.50	1.52
June 21 to July 28, . . .	131.81	222.00	48.56	1:4.45	143.50	200.75	1.55

Total Amount of Feed consumed from March 23, 1892, to July 28, 1892.

	Dry Matter (Pounds).	Cost.	Manurial Value.
228.93 pounds corn meal, . . .	196.97	$2 75	$0 66
747.00 quarts skim-milk, . . .	76.34	3 36	1 58
92.06 pounds gluten feed, . .	83.80	1 06	0 58
	357.11	$7 17	$2 82

	Pounds.
Live weight of animal at the beginning of the experiment, .	35.00
Live weight of animal at the time of killing, ...	200.75
Live weight gained during the experiment, ...	165.75
Dressed weight of animal, ...	157.00
Loss in weight by dressing, 21.79 per cent., or	43.75
Dressed weight gained during the experiment, ...	129.63

Pounds of dry matter fed produced 1 pound of live weight, 2.15.

Pounds of dry matter fed produced 1 pound of dressed weight, 2.75.

Cost of feed per pound of dressed weight gained, 5.53 cents.

Net cost of feed per pound of dressed weight gained after deducting 30 per cent. of manurial value, 4.01 cents.

V.

COMPILATION OF THE AMOUNT OF DIGESTIBLE NUTRIENTS CONSUMED DAILY IN THE DIFFERENT FEEDING EXPERIMENTS MADE AT THE MASSACHUSETTS STATE EXPERIMENT STATION (Compiled by Dr. J. B. Lindsey).

1886–92.

Milch Cows — Steers — Lambs.

1. *Milch Cows.*

Number of Cows.	Kind of Feed.	Total Dry Matter (Pounds).	Digestible Matter consumed Daily per 1,000 Pounds Live Weight.				Nutritive Ratio.
			Organic Matter (Pounds).	Protein (Pounds).	Carbohydrates (Pounds).	Fat (Pounds).	
	Winter Season.						
	1886.						
2	Grain and hay, ...	27.83	16.78	1.98	14.64	0.48	1:8.0
2	Grain, hay and corn fodder, . . .	24.61	16.49	1.96	14.00	0.53	1:7.8
2	Grain, hay and ensilage, ...	19.73	13.01	1.35	11.16	0.47	1:9.1
2	Grain, hay and roots, ...	26.70	17.94	2.29	15.22	0.42	1:7.1
	General average, ...	24.72	16.05	1.89	13.75	0.47	1:7.9
	1887.						
3	Grain and hay, ...	28.45	18.41	2.53	15.20	0.59	1:6.7
3	Grain, hay and ensilage, ...	22.17	16.29	2.48	13.27	0.87	1:6.2
3	Grain and corn fodder, ...	24.35	17.18	2.11	14.50	0.57	1:7.6
3	Grain, hay and carrots, ...	22.69	16.41	2.54	13.44	0.60	1:5.9
	General average, ...	24.42	17.07	2.42	14.10	0.66	1:6.6
	1888.						
6	Grain and hay, ...	25.47	16.12	2.35	13.40	0.58	1:6.3
6	Grain and corn fodder, ...	23.80	16.33	2.43	13.23	0.67	1:6.2
6	Grain and corn stover, ...	19.28	13.69	2.21	10.89	0.58	1:5.6
6	Grain, hay and ensilage, . . .	21.63	14.71	2.30	11.83	0.59	1:6.0
	General average, ...	22.54	15.21	2.32	12.34	0.61	1:6.0

1. *Milch Cows* — Continued.

Number of Cows.	Kind of Feed.	Total Dry Matter (Pounds).	Digestible Matter consumed Daily per 1,000 Pounds Live Weight.				Nutritive Ratio.
			Organic Matter (Pounds).	Protein (Pounds).	Carbohydrates (Pounds).	Fat (Pounds).	
	Winter Season.						
	1889.						
9	Grain and hay,	26.64	17.46	2.56	14.39	0.51	1:6.1
6	Grain and corn fodder,	18.95	14.39	2.23	11.69	0.47	1:5.8
5	Grain and corn stover,	19.42	14.77	2.16	12.15	0.46	1:6.1
7	Grain, hay and ensilage,	24.58	17.83	2.54	14.41	0.88	1:6.5
5	Grain, hay and carrots,	22.52	16.53	2.42	13.62	0.48	1:6.2
5	Grain, hay and sugar beets,	25.38	19.09	2.78	15.82	0.49	1:6.1
	General average,	22.91	16.68	2.45	13.68	0.55	1:6.1
	1890.						
6	Grain and rowen,*	27.31	17.25	3.11	13.47	0.68	1:4.88
3	Grain, hay and ensilage,	26.32	18.26	2.69	14.57	0.99	1:6.30
5	Grain, corn fodder and carrots,	21.87	15.08	2.62	12.07	0.49	1:5.10
6	Grain, corn stover and carrots,	22.16	16.20	2.72	12.91	0.57	1:5.31
5	Grain, hay and turnips,	25.70	17.09	2.81	13.73	0.54	1:5.40
	General average,	24.67	16.78	2.80	13.35	0.65	1:5.35
	1891.						
6	Grain and hay,*	24.98	16.17	2.39	13.33	0.57	1:6.15
7	Grain and rowen,	26.52	16.30	3.09	13.07	0.78	1:5.00
5	Grain, hay and corn and soja bean ensilage.	29.10	19.14	3.77	14.29	1.08	1:4.50
5	Grain and corn stover,	22.36	15.91	2.31	12.98	0.61	1:6.30
	General average,	25.74	16.88	2.89	13.42	0.76	1:5.30
	Wolff's standard,	-	15.93	2.66	12.67	0.60	1:5.30
	Summer Season.						
	1887.						
5	Grain and hay,	26.85	16.44	1.79	14.06	0.51	1:8.52
3	Grain, hay and vetch and oats (green),	31.39	17.46	2.32	13.36	0.67	1:6.53
3	Grain, hay and cow-pea,	34.17	21.33	2.23	18.50	0.69	1:9.07
3	Grain, hay and serradella,	33.02	17.40	2.67	14.13	0.60	1:5.85
	General average,	31.36	18.16	2.25	15.01	0.62	1:7.40

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* The *absolute quantity* of the different grains was constant throughout the year's experiment. At times, however, one kind was substituted for another.

1. *Milch Cows* — Concluded.

Number of Cows.	KIND OF FEED.	Total Dry Matter (Pounds).	DIGESTIBLE MATTER CONSUMED DAILY PER 1,000 POUNDS LIVE WEIGHT.				Nutritive Ratio.
			Organic Matter (Pounds).	Protein (Pounds).	Carbohydrates (Pounds).	Fat (Pounds).	
	Summer Season.						
	1888.						
5	Grain and hay,	27.74	17.25	2.60	14.08	0.58	1:6.00
5	Grain and rowen,	29.50	18.49	3.27	14.56	0.63	1:4.93
5	Grain, hay and vetch and oats,	30.49	18.98	3.05	15.20	0.59	1:5.55
5	Grain, hay and cow-pea,	29.88	19.04	3.66	15.04	0.65	1:4.55
	General average,	29.40	18.44	3.14	14.72	0.61	1:5.20
	1889.						
6	Grain and hay,	25.19	16.10	2.35	13.44	0.50	1:6.25
6	Grain, hay and serradella,	25.88	17.05	3.17	13.37	0.58	1:4.57
6	Grain, hay and vetch and oats,	23.41	15.01	2.15	12.34	0.52	1:6.34
6	Grain, hay and cow-pea,	25.33	17.03	2.49	13.94	0.60	1:6.20
	General average,	24.95	16.30	2.54	13.27	0.55	1:5.80
	1890.						
6	Grain and rowen,	28.42	18.13	3.26	14.17	0.70	1:4.9
6	Grain, hay and vetch and oats,	27.35	17.58	2.76	14.19	0.64	1:5.7
6	Grain, hay and soja bean,	31.05	19.36	3.59	15.62	0.65	1:4.8
	General average,	28.94	18.36	3.20	14.66	0.66	1:5.1
	1891.						
5	Grain, rowen and vetch and oats,	33.47	19.14	2.77	15.59	0.78	1:6.3
5	Grain, rowen and soja bean,	29.66	18.84	3.32	14.37	0.65	1:5.0
	General average,	31.56	18.94	3.04	14.98	0.71	1:5.6
	Wolff's standard,	–	15.93	2.66	12.67	0.60	1:5.3

2. *Steers.*

Number of Steers.	Age (Years).	KIND OF FEED.	Total Dry Matter (Pounds).	DIGESTIBLE MATTER CONSUMED DAILY PER 1,000 POUNDS LIVE WEIGHT.				Nutritive Ratio.
				Organic Matter (Pounds).	Protein (Pounds).	Carbohydrates (Pounds).	Fat (Pounds).	
		1889-90.						
2	1	Grain and corn stover, . . .	13.72	9.83	1.78	7.61	0.43	1:4.8
2	1	Grain and corn ensilage, . . .	25.91	18.21	3.24	13.95	1.15	1:5.2
2	1	Grain and corn fodder, . . .	19.63	13.63	2.47	10.56	0.60	1:4.9
2	1	Grain, corn stover and sugar beets, .	14.86	11.15	2.13	8.54	0.48	1:4.6
		General average, ...	18.53	12.95	2.41	10.16	0.67	1:4.9
		1890-91.						
3	1	Grain and hay, ...	20.54	12.41	2.45	9.36	0.59	1:4.5
3	1	Grain, hay and roots, ...	21.89	13.50	2.79	10.08	0.62	1:4.5
3	1	Grain, hay and ensilage, . . .	20.49	12.50	2.75	9.03	0.72	1:4.0
		General average, ...	20.97	12.80	2.66	9.49	0.64	1:4.3
		Wolff's standard, ...	–	15.08	2.17	12.54	0.37	1:6.25
		1889-90.						
2	2	Grain and corn stover, . . .	11.95	8.49	1.42	6.73	0.34	1:5.5
2	2	Grain and corn ensilage, . . .	20.79	14.22	2.02	11.33	0.86	1:6.6
2	2	Grain and corn fodder, . . .	15.51	10.89	1.94	8.48	0.47	1:4.9
		General average, ...	16.10	11.20	1.79	8.85	0.56	1:5.7
		1890-91.						
2	2	Grain, hay and turnips, . . .	19.87	12.68	2.55	9.59	0.55	1:4.3
2	2	Grain and ensilage, ...	18.33	11.75	2.32	8.84	0.59	1:4.4
2	2	Grain and hay, ...	19.36	11.69	2.32	8.81	0.56	1:4.4
		General average, ...	19.19	12.04	2.39	9.08	0.57	1:4.4
		1891-92.						
3	2	Grain, hay and roots, ...	16.75	11.19	1.82	8.90	0.47	1:5.6
3	2	Grain and ensilage, ...	13.48	9.44	1.63	7.24	0.36	1:5.3
3	2	Grain and corn stover, . . .	14.23	9.92	1.65	7.83	0.44	1:5.4
		General average, ...	14.82	10.18	1.70	7.99	0.42	1:5.4
		Wolff's standard, ...	–	15.08	2.17	12.54	0.37	1:6.25

3. *Lambs.*

Number of Lambs.	Age (Months).	KIND OF FEED.	Total Dry Matter (Pounds).	DIGESTIBLE MATTER CONSUMED DAILY PER 1,000 POUNDS LIVE WEIGHT.				Nutritive Ratio.
				Organic Matter (Pounds).	Protein (Pounds).	Carbohydrates (Pounds).	Fat (Pounds).	
		1889-90.						
		Narrow Ration.						
3	8-12	Grain and rowen, ...	31.37	20.15	3.88	15.38	0.89	1:4.5
3	8-12	Grain, rowen and corn ensilage, .	28.58	19.53	3.47	15.03	1.03	1:5.1
3	8-12	Grain and corn ensilage, . . .	23.68	15.81	2.89	12.90	1.02	1:5.3
		General average, . . .	27.88	18.49	3.41	14.44	0.98	1:5.0
		Wide Ration.						
3	8-12	Grain and rowen, ...	27.48	14.60	2.31	14.68	0.61	1:7.0
3	8-12	Grain, rowen and ensilage, . .	21.42	14.50	1.71	12.15	0.64	1:8.0
3	8-12	Grain and ensilage, ...	22.26	15.54	2.55	12.05	0.94	1:5.6
		General average, . . .	23.72	14.88	2.19	12.96	0.73	1:6.8
		1890-91.						
		Wide Ration.						
3	8-12	Grain and rowen, ...	28.85	19.16	3.09	15.26	0.81	1:5.7
3	8-12	Grain, rowen and ensilage, . .	23.60	17.04	2.16	14.24	0.64	1:7.3
		General average, . . .	26.22	18.10	2.62	14.75	0.73	1:6.5
		Narrow Ration.						
3	8-12	Grain and rowen, ...	31.90	19.93	3.92	15.09	0.92	1:4.45
3	8-12	Grain, rowen and ensilage, . .	24.59	16.40	2.88	12.75	0.77	1:5.10
		General average, . . .	28.24	18.16	3.40	13.92	0.84	1:4.77
		1891-92.						
6	8-12	Grain and rowen, ...	22.38	14.38	2.62	11.05	0.71	1:4.8
6	8-12	Grain, rowen and ensilage, . .	20.38	13.53	2.33	10.49	0.71	1:5.2
6	8-12	Grain, rowen and mangolds, . .	20.19	14.55	2.49	11.54	0.52	1:5.2
		General average, . . .	20.98	14.12	2.48	11.03	0.65	1:5.1
		Wolff's standard, . . .	-	17.58	3.08	14.08	0.42	1:5.0

PART II.

ON

FIELD EXPERIMENTS

AND

OBSERVATIONS IN VEGETABLE PHYSIOLOGY

AND

PATHOLOGY.

1. Field Experiments to ascertain the Effect of the Exclusion of Every Form of Nitrogen-containing Manurial Matter from the Fertilizer applied for the Production of a Leguminous Crop — Soja Bean — on its Yield per Acre (Field A).
2. Field Experiments with Prominent Varieties of Grasses and with Grass Mixtures under fairly Corresponding Circumstances (Field B).
3. Field Experiments regarding the Effect of Different Combinations of Commercial Fertilizers on the Yield of Some Prominent Garden Crops (Field C).
4. Observations regarding the Adaptation of a Variety of More or Less Reputed Fodder Plants new to our Section of the Country (Field D).
5. Field Experiments with Different Commercial Phosphates, to study the Economy of using the Cheaper Natural Phosphates or the More Costly Acidulated Phosphates (Field F).
6. Field Experiments with Mixed Forage Crops for Green Fodder and Hay, Vetch and Oats, Canada Peas and Oats.
7. Observations on Permanent Grass Lands — Meadows.
8. Report on General Farm Work.
9. Report of Prof. James E. Humphrey on Various Diseases of Plants, with Observations in the Field and Vegetation House.

1. Field Experiments carried on for the Purpose of ascertaining the Effect of the Exclusion of Every Form of Nitrogen-containing Manurial Matter from the Fertilizer applied for the Production of a Leguminous Crop (Clover-like Plants) on the Yield, as compared with the Results obtained when a Liberal Amount of Various Nitrogen-containing Manurial Substances is applied under Otherwise Corresponding Circumstances for the Same Purpose.*

Field A.

The unbroken record of this field extends over more than twenty years. The systematic treatment of the soil, as far as modes of cultivation and of manuring are concerned, was introduced during the season of 1883–84. The subdivision of the entire area into eleven plats (one-eighth of an acre each), of a uniform size and shape, one hundred and thirty feet long and thirty feet wide, with an unoccupied and unmanured space of five feet in width between adjoining plats, has been retained unaltered since 1884. A detailed statement of the particular aim and general management of our experiments, as well as of the results obtained in that connection from year to year, forms a prominent part of our contemporary printed annual reports, to which I have to refer for details.

Since 1889 the main object of observations upon the same field has been to study the influence of an entire exclusion of any additional nitrogen-containing manurial substance from the soil under cultivation, as well as of a definite additional supply of nitrogen in different forms of combination, on the character and yield of the crop selected for the trial. The treatment of the soil adopted in preceding years favored this new project for field observations.

Several plats which for five preceding years did not receive any nitrogen compound for manurial purposes were retained in that state, to study the effect of an entire exclusion of nitrogen-containing manurial substances on the crop under cultivation, while the remaining ones received as before a definite amount of nitrogen in the same form in which they had received it in preceding years; namely, either as sodium nitrate or as ammonium sulphate, or as organic nitrogenous matter in form of dried blood. A corresponding amount of available nitrogen was applied in all these cases.

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* Soja bean served for the observation.

Aside from the difference regarding the nitrogen supply, all plats were treated alike. They each received without an exception a corresponding amount of available phosphoric acid and of potassium oxide. The phosphoric acid was supplied in form of dissolved bone-black, and the potassium oxide either in form of muriate of potash or of potash-magnesia sulphate. From 120 to 130 pounds of potassium oxide, from 80 to 85 pounds of available phosphoric acid and from 40 to 50 pounds of available nitrogen were supplied per acre.

One plat marked 0 received its main supply of phosphoric acid, potassium oxide and nitrogen in form of barn-yard manure; the latter was carefully analyzed before being applied, to determine the amount required to secure, as far as practicable, the desired corresponding proportion of essential fertilizing constituents. The deficiency in potassium oxide and phosphoric acid was supplied by potash-magnesia sulphate and dissolved bone-black. The fertilizer for this plat consisted of 800 pounds of barn-yard manure, 32 pounds of potash-magnesia sulphate and 18 pounds of dissolved bone-black.

The mechanical preparation of the soil, the incorporation of the manurial substances, — the general character of the latter being the same, — the seeding, cultivating and harvesting were carried on year after year in a like manner, and as far as practicable on the same day in case of every plat during the same year.

This course in the general management of the experiment has been followed thus far for three successive years — 1889, 1890 and 1891 — in connection with different crops: —

Corn (maize), in 1889 (see seventh annual report); oats, in 1890 (see eighth annual report); rye, in 1891 (see ninth annual report).

The following tabular statement shows the annual application and special distribution of the manurial substances with reference to each plat since 1889. The fertilizers were in every case applied broadcast as early as circumstances permitted. They were slightly harrowed under before the seed was planted in rows by a seed drill. Each plat received the same amount of seed.

PLATS.	Annual Supply of Manurial Substances.
Plat 0,	800 lbs. of barn-yard manure, 32 lbs. of potash-magnesia sulphate and 18 lbs. of dissolved bone-black.
Plat 1,	29 lbs. sodium nitrate (= 4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 2,	29 lbs. sodium nitrate (= 4 to 5 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8 5 lbs. available phosphoric acid).
Plat 3,	43 lbs. dried blood (= 5 to 6 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 4,	25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 5,	22.5 lbs. ammonium sulphate (= 4 to 5 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 6,	22.5 lbs. ammonium sulphate (= 4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 7,	25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 8,	22.5 lbs. ammonium sulphate (= 4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 9,	25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 10,	43 lbs. dried blood (= 5 to 6 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).

1892. — The field was ploughed April 19 and 20. The barn-yard manure was applied to Plat 0 April 15; the remaining plats, 1–10, received May 6 their different mixtures of commercial fertilizers, broadcast, after which the entire field was harrowed and rolled. The seed was sown in drills two and one-half feet apart May 16, at the rate of seven pounds to each plat.

The soja bean seed, a late maturing variety, was bought of J. M. Thorburn & Co., New York City, at eight cents per pound. The crop was cut for ensilage September 8.

The young plants appeared above ground May 28; they were cultivated and hoed June 3 and July 17, when they shaded the ground sufficiently to prevent any serious appearance of weeds. The variation in the color of the crop was quite marked in different plats during the earlier stages of its growth. Those plats which received an addition of nitrogen in form of nitrate of soda showed a deeper green color than those which received other forms of nitrogen, in particular, sulphate of ammonia; while those that received no addition of nitrogen maintained a light green color until the close of the season.

Height of the Plants upon Different Plats during the Season.

PLATS.	July 8.	July 15.	July 22.	July 29.	Aug. 5.	Aug. 12.	Aug. 19.	Aug. 26.	Sept. 2.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
Plat 0, . .	13	17	25	30	31	36	41	44	44
Plat 1, . .	12	17	25	30	33	38	40	44	44
Plat 2, . .	13	17	24	31	33	37	40	43	45
Plat 3, . .	13	16	24	30	35	38	41	45	46
Plat 4, . .	12	14	21	29	29½	31	34	38	39
Plat 5, . .	11	15	21	28	30	33	36	40	42
Plat 6, . .	12	16	24	30	32	34	39	42	43
Plat 7, . .	10	13	18	24	27	32	35	40	41
Plat 8, . .	8	9	13	20	22	23	29	33	35
Plat 9, . .	9	10	18	23	26	26	32	37	39
Plat 10, . .	12	14	21	27	30	34	39	42	43

Yield of Crop on Different Plats.

CUT SEPTEMBER 7 AND 8.	Weight of Green Soja Bean (Pounds).	Yield per Acre (Tons).
Plat 0, ...	2,210	11.050
Plat 1, ...	2,290	11.450
Plat 2, ...	2,290	11.450
Plat 3, ...	2,090	10.450
Plat 4, ...	1,440	7.200
Plat 5, ...	1,935	9.675
Plat 6, ...	1,970	9.850
Plat 7, ...	1,430	7.150
Plat 8, ...	1,450	7.250
Plat 9, ...	1,460	7.300
Plat 10, ...	1,490	7.450

Analysis of the Plants from Plat 0.

	Per Cent.
Moisture at 100° C.,	73.20
Dry matter,	26.80
	100.00

Analysis of Dry Matter.

Crude ash,	6.80
" cellulose,	30.54
" fat,	2.29
" protein,	6.82
Nitrogen-free extract matter,	53.55
	100.00

An examination of the above tabular statement of the yield of each plat shows, in every case where no additional nitrogen in any form has been applied in connection with the phosphoric acid and potash used as fertilizer (plats 4, 7, 9), a decided falling off in the yield; fully one-third less than where barn-yard manure and nitrate of soda have furnished the nitrogen supply (plats 0, 1, 2, 3).

Plat 8 shows the same exceptional condition which has been noticed in preceding years, when it seriously suffered from the attack of some parasitic enemy. The low yield of Plat 10 is evidently due to the use of a lower rate of seed, being the first plat to adjust the seed drill for a definite amount of seed.

Conclusion. — The importance of a liberal additional supply of nitrogen to the soil for a successful production of farm crops under otherwise corresponding circumstances finds a strong confirmation in our late experiments in that direction, as may be noticed in the subsequent compiled tabular statement of the results of three years' observations.

Summary of Three Years' Observations upon Field A (1890–92).

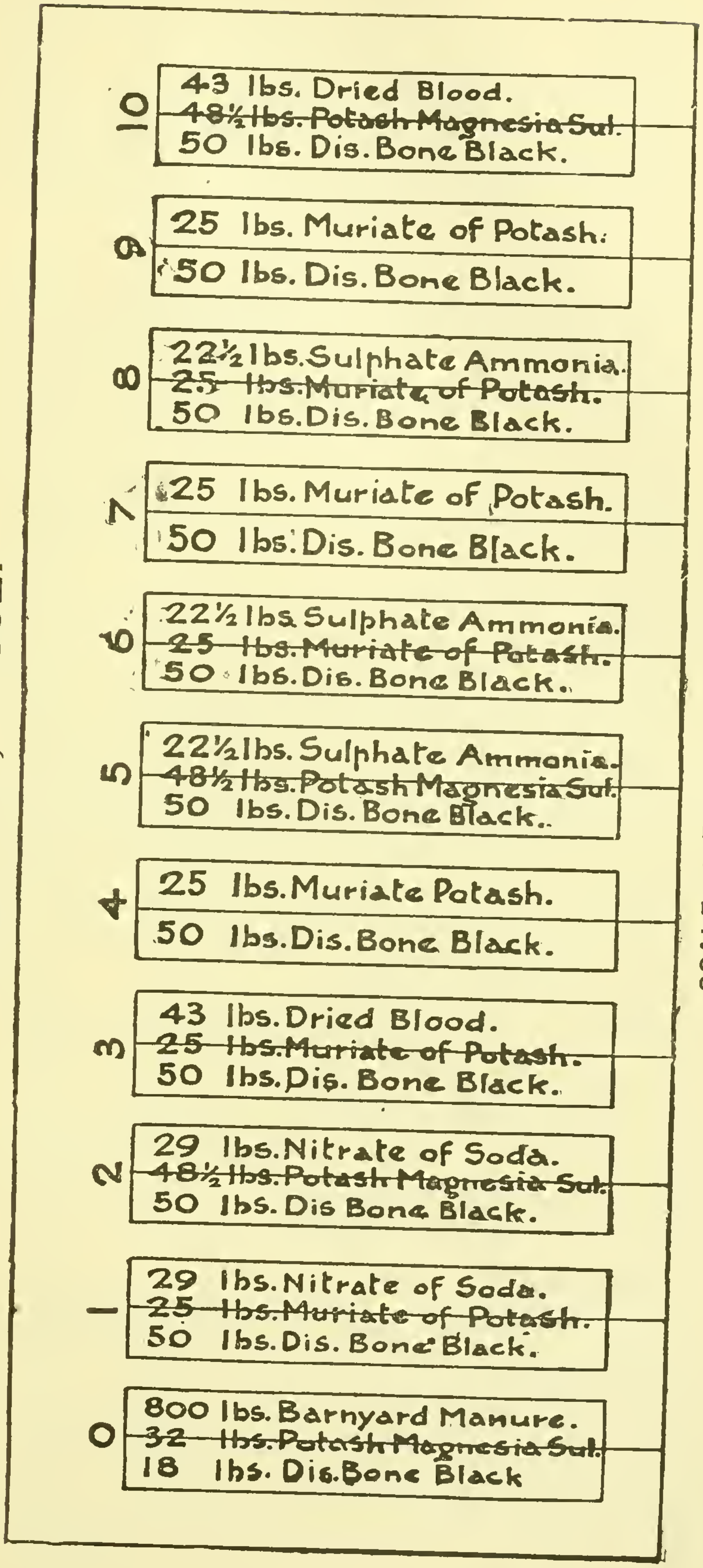
Number of Plat.	MANURIAL MATTER APPLIED.	1890. Yield of Oats.			1891. Yield of Rye.					1892.
		Crop (Pounds).	Percentage of Grain.	Percentage of Straw and Chaff.	Crop (Pounds).	Percentage of Grain.	Percentage of Straw and Chaff.	Yield of Grain (Pounds).	Yield of Straw (Pounds).	Yield of Green Soja Bean (Pounds).
Plat 0,	800 lbs. of barn-yard manure, 32 lbs. of potash-magnesia sulphate and 18 lbs. of dissolved bone-black, ...	315	38.10	61.90	470	30.21	69.79	142	328	2,210
Plat 1,	29 lbs. sodium nitrate (=4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (=12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (=8.5 lbs. available phosphoric acid),	362	35.36	64.64	570	27.02	72.98	154	416	2,290
Plat 2,	29 lbs. sodium nitrate (=4 to 5 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (=12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (=8.5 lbs. available phosphoric acid), .	365	35.34	64.66	525	25.52	74.48	134	391	2,290
Plat 3,	43 lbs. dried blood (=5 to 6 lbs. nitrogen), 25 lbs. muriate of potash (=12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (=8.5 lbs. available phosphoric acid), . .	345	33.62	66.38	475	27.37	72.63	130	345	2,090
Plat 4,	25 lbs. muriate of potash (=12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (=8.5 lbs. available phosphoric acid), ...	260	34.61	63.39	390	27.44	72.56	107	283	1,440
Plat 5,	22.5 lbs. ammonium sulphate (=4 to 5 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (=12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (=8.5 lbs. available phosphoric acid), ...	360	39.20	60.80	530	27.36	72.64	145	385	1,935
Plat 6,	22.5 lbs. ammonium sulphate (=4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (=12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid),	385	32.21	67.79	400	25.50	74.50	102	298	1,970
Plat 7,	25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid), ...	320	34.40	65.60	450	24.22	75.78	109	341	1,430
Plat 8,	22.5 lbs. ammonium sulphate (=4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (=12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (=8.5 lbs. available phosphoric acid), .	220	26.82	73.18	-	-	-	-	-	1,450
Plat 9,	25 lbs. muriate of potash (=12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (=8.5 lbs. available phosphoric acid), ...	290	34.83	65.17	425	25.65	74.35	109	316	1,460
Plat 10,	43 lbs. dried blood, (=5 to 6 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (=12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (=8.5 lbs. available phosphoric acid),	395	35.44	64.56	425	29.41	70.59	125	300	1,490

The crop when harvested, September 7 and 8, to serve for the production of a mixed ensilage (soja bean and fodder corn), showed no signs of seed pods or blossoms. It differed in this respect decidedly from other early maturing varieties, white and black soja beans, which have been raised and described by us in preceding annual reports.

The advantage, if any, of this new variety of soja bean consists in the large amount of vegetable matter it produces, as compared with the early maturing varieties.

[1. Analysis of an early variety of soja bean with pods (whole plant); 2. Analysis of soja bean seed; 3. Analysis of soja bean straw (matured plant, early variety).]

	PER CENT		
	1.	2.	3.
Moisture at 100° C.,	10.90	14.17	7.63
Dry matter,	89.10	85.83	92.37
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	6.90	5.84	10.72
" cellulose,	22.79	6.02	36.80
" fat,	6.77	20.19	3.49
" protein,	16.68	33.97	5.34
Nitrogen-free extract matter,	46.86	33.98	43.65
	100.00	100.00	100.00



Field "A," 1892.

SCALE, 4 RODS TO 1 INCH.

10
43 lbs. Dried Blood.
~~48½ lbs. Potash Magnesia Sul.~~
50 lbs. Dis. Bone Black.
9
25 lbs. Muriate of Potash.
50 lbs. Dis. Bone Black.
8
22½ lbs. Sulphate Ammonia.
~~25 lbs. Muriate of Potash.~~
50 lbs. Dis. Bone Black.
7
25 lbs. Muriate of Potash.
50 lbs. Dis. Bone Black.
6
22½ lbs. Sulphate Ammonia.
~~25 lbs. Muriate of Potash.~~
50 lbs. Dis. Bone Black.
5
22½ lbs. Sulphate Ammonia.
~~48½ lbs. Potash Magnesia Sul.~~
50 lbs. Dis. Bone Black.
4
25 lbs. Muriate Potash.
50 lbs. Dis. Bone Black.
3
43 lbs. Dried Blood.
~~25 lbs. Muriate of Potash.~~
50 lbs. Dis. Bone Black.
2
29 lbs. Nitrate of Soda.
~~48½ lbs. Potash Magnesia Sul.~~
50 lbs. Dis Bone Black.
1
29 lbs. Nitrate of Soda.
~~25 lbs. Muriate of Potash.~~
50 lbs. Dis. Bone Black.
0
800 lbs. Barnyard Manure.
~~32 lbs. Potash Magnesia Sul.~~
18 lbs. Dis. Bone Black

2. Field Experiments with Prominent Varieties of Grasses, raised either Single or in Mixture, under Otherwise Corresponding Conditions, to ascertain their Economical Value as far as Yield and Composition are concerned (1892).

Field B.

This field occupies an area of one and seven-tenths acres, and runs from north to south, nearly on a level. The soil consists of a somewhat sandy loam of several feet in depth. The systematic treatment of the area was inaugurated in 1884, when the present subdivision into eleven plats was first introduced. The plats are 175 feet long and 33 feet wide (5,775 square feet, or two-fifteenths of an acre), of a uniform shape, running from east to west, with a space of five feet between adjoining plats. The numbering begins at the north end with 11, and closes at the south end with 21. From 1884 to 1889 every alternate plat received annually the same kind and the same amount of fertilizer, — 600 pounds of fine-ground bone and 200 pounds of muriate of potash per acre. The space of five feet left between the different succeeding plats has been kept clean from any growth by a constant use of the cultivator, and received at no time any kind of manure.

The details of the work carried on upon Field B have been thus far reported from year to year in our annual reports. The chemical analyses of the crops raised upon this field, on account of the amount of work involved, have been quite frequently published in later bulletins or in annual reports of the succeeding year.

A material change in the above-stated management of the field was made in 1889, with reference to the previously unmanured plats, 12, 14, 16, 18 and 20; they were subsequently annually manured in exactly the same manner as the remaining plats, receiving per acre 600 pounds of fine-ground bone and 200 pounds of muriate of potash. The character of the crops raised upon the various plats from 1888 to 1892 may be seen from the following tabular statement: —

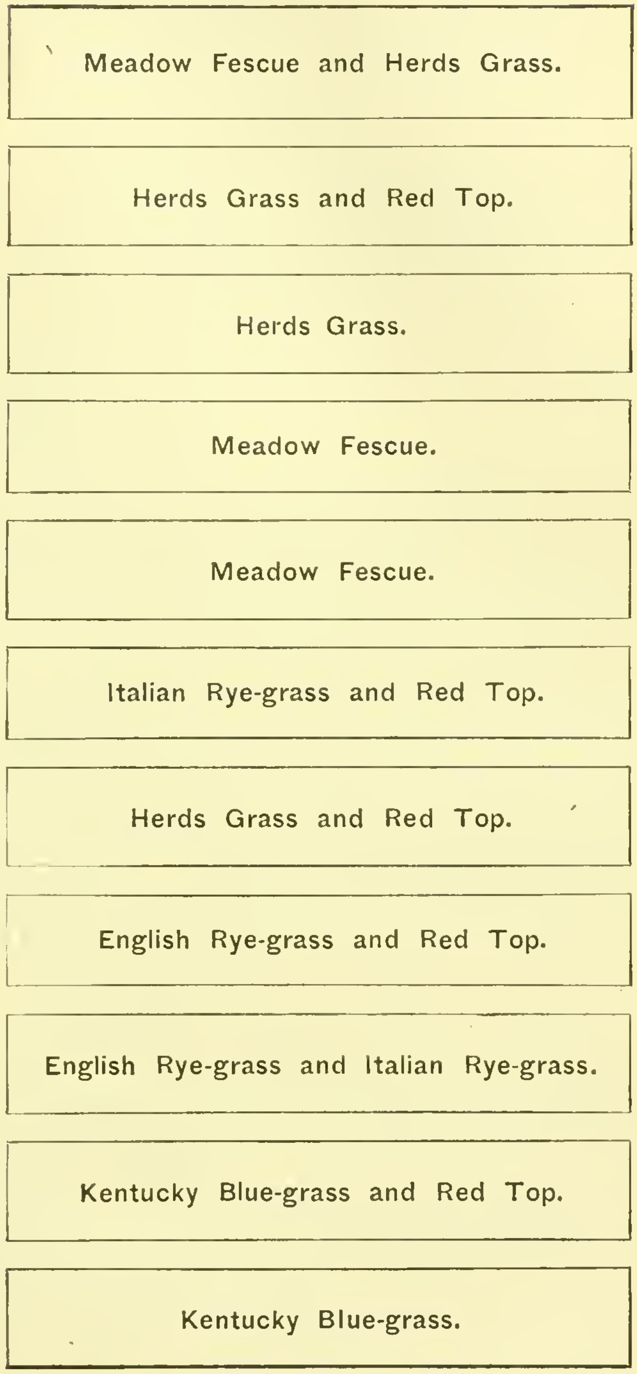
Plats.	1889.	1890.	1891.
Plat 11,	Kentucky blue-grass,	Kentucky blue-grass, sown Sept. 24, 1889,	Kentucky blue-grass, sown Sept. 24, 1889.
Plat 12,	Kentucky blue-grass,	Kentucky blue-grass, sown Sept. 24, 1889,	Kentucky blue-grass, sown Sept. 24, 1889.
Plat 13,	Red-cob ensilage corn,	Red top, sown Sept. 24, 1889,	English rye-grass, north, sown Sept. 29, 1889. Italian rye-grass, south, sown Sept. 29, 1889.
Plat 14,	Red-cob ensilage corn,	Red top, sown Sept. 24, 1889,	English rye-grass and red top, sown Sept. 29, 1890.
Plat 15,	Bokhara clover (*Melilotus alba*), Sainfoin (*Onobrychis sativa*),	Bokhara clover, sown May 8, 1889, Sainfoin, sown May 8, 1889,	Herds grass and red top, sown April 23, 1890.
Plat 16,	Bokhara clover, Sainfoin,	Rhode Island bent (*Agrostis alba*), sown Sept. 25, 1889,	Italian rye-grass and red top, sown April 23, 1890.
Plat 17,	Meadow fescue,	Meadow fescue, sown September, 1887,	Meadow fescue, sown September, 1887.
Plat 18,	Red-cob ensilage corn,	Meadow fescue, sown September, 1889,	Meadow fescue, sown Sept. 29, 1890.
Plat 19,	Alsike clover, Medium red clover,	Herds grass, sown September, 1889,	Herds grass, sown Sept. 25, 1889.
Plat 20,	Red-cob ensilage corn,	Red top and herds grass mixed, sown September, 1889,	Herds grass and red top, sown Sept. 29, 1890.
Plat 21,	Corn (variety, Clark),	Meadow fescue and herds grass, mixed, sown September, 1889,	Meadow fescue and red top, sown Sept. 29, 1890.

1891. — Previous to the year 1891 other crops than grasses have been cultivated upon some plats at times. Of late none but single grasses or mixtures of reputed grasses have been planted. The single grasses are raised as in previous years, in rows two feet apart; grass mixtures are seeded down broadcast. The manure in case of single grasses is applied by hand between the rows, and is subsequently slightly ploughed in by means of a cultivator; in case of grass mixtures the manure is applied as top dressing early in the spring. In both cases the first manure is applied broadcast and ploughed under before seeding down the grass.

Crops raised in 1892.

PLATS.	1892.
Plat 11, .	Kentucky blue-grass, sown Sept. 24, 1889.
Plat 12, .	Kentucky blue-grass and red top, sown Sept. 18, 1891.
Plat 13,	English rye-grass and Italian rye-grass, sown Sept. 29, 1890.
Plat 14, .	English rye-grass and red top, sown Sept 29, 1890.
Plat 15, .	Herds grass and red top, sown April 23, 1891.
Plat 16, .	Italian rye-grass and red top, sown April 23, 1891
Plat 17, .	Meadow fescue, sown Sept. 25, 1887.
Plat 18, .	Meadow fescue, sown Sept. 29, 1890.
Plat 19, .	Herds grass, sown Sept. 25, 1889.
Plat 20, .	Herds grass and red top, sown Sept. 29, 1890.
Plat 21, .	Meadow fescue and herds grass, sown Sept. 18, 1891.

AREA OF EACH PLAT, TWO-FIFTEENTHS ACRE.	Yield of Hay, First and Second Cut (Pounds).	Rate per Acre (Pounds).
Plat 11, sown Sept. 24, 1889, ...	335	2,513
Plat 12, sown Sept. 18, 1891, ...	365	2,737
Plat 13, sown Sept. 29, 1890, ...	255	1,913
Plat 14, sown Sept. 29, 1890, ...	225	1,688
Plat 15, sown April 23, 1891, ...	565	4,238
Plat 16, sown April 23, 1891, ...	565	4,238
Plat 17, sown Sept. 25, 1887, ...	475	3,563
Plat 18, sown Sept. 29, 1890, ...	490	3,675
Plat 19, sown Sept. 25, 1889, ...	610	4,575
Plat 20, sown Sept. 29, 1890, ...	285	2,138
Plat 21, sown Sept. 18, 1891, ...	355	2,663
Total, ...	4,525	


21 Meadow Fescue and Herds Grass.
20 Herds Grass and Red Top.
19 Herds Grass.
18 Meadow Fescue.
17 Meadow Fescue.
16 Italian Rye-grass and Red Top.
15 Herds Grass and Red Top.
14 English Rye-grass and Red Top.
13 English Rye-grass and Italian Rye-grass.
12 Kentucky Blue-grass and Red Top.
11 Kentucky Blue-grass.

Field "B," 1892.

Scale, 4 rods to 1 inch.

3. FIELD EXPERIMENTS REGARDING THE EFFECT OF DIFFERENT COMBINATIONS OF COMMERCIAL FERTILIZERS ON THE YIELD AND THE CHARACTER OF SEVERAL PROMINENT GARDEN CROPS (1892).

Field C.

1891. — The observations upon Field C with different combinations of commercial fertilizers on the yield and character of some prominent garden crops began during the spring of 1891. The portion of Field C devoted to this experiment during 1891 consisted of one-half of its entire area, running from east to west along its south side (328 feet long and 88 feet wide). It was subdivided into five plats of corresponding size and shape (88 by 62 feet), one-eighth of an acre. These plats were separated from each other and from other cultivated land adjoining by a space of five feet of unmanured and unseeded land. The soil is several feet deep, and consists of a rather light loam in a good state of cultivation; 600 pounds of fine-ground bone and 200 pounds of muriate of potash per acre were used for several years previous to 1891 as the annual manure supply. The field slopes gently from west to east. The plats were numbered 1, 2, 3, 4, 5, beginning at the east end of the field. Each plat received during the spring of 1891 a manurial mixture of its own as fertilizer.

The difference of the fertilizers applied consisted essentially in the circumstance that nitrogen and potash were used in several of them in different forms. All plats received practically the same quantity of nitrogen, potash and phosphoric acid, and every one of them received its phosphoric acid addition in the same form, namely, dissolved bone-black. Some plats received their nitrogen supply in the form of organic animal matter, dried blood; others received their nitrogen in the form of sodium nitrate, Chili saltpetre; others in the form of ammonium sulphate. Some plats received their potash in the form of muriate of potash and others in the form of the highest grade of potassium sulphate (in our market 95 per cent.). The subsequent tabular statement shows the quantities of the manurial substances applied to different plats: —

Plat 1, ...	75 pounds dried blood. 30 pounds muriate of potash. 40 pounds dissolved bone-black.
Plat 2, ...	47 pounds nitrate of soda. 30 pounds muriate of potash. 40 pounds dissolved bone-black.
Plat 3, ...	38 pounds sulphate of ammonia. 30 pounds muriate of potash. 40 pounds dissolved bone-black.
Plat 4, ...	47 pounds nitrate of soda. 30 pounds high-grade sulphate of potash. 40 pounds dissolved bone-black.
Plat 5, ...	38 pounds sulphate of ammonia. 30 pounds high-grade sulphate of potash. 40 pounds dissolved bone-black.

		Pounds.
Per acre :	Phosphoric acid, ...	50.4
	Nitrogen, ...	60.0
	Potassium oxide, ...	120.0

The different fertilizers were applied broadcast, and subsequently slightly ploughed under, in all cases on the same day (April 22, 1891). All plats were planted in the same order with the same kind of garden crops (eight). Every plat was either planted with young plants or was sown with the seed, as circumstances dictated, each kind on the same day and in the same manner. The young plants used for the experiment were raised under corresponding conditions from seed in a hot-bed. The different kinds of garden crops were arranged in the following order, beginning on the east side of each plat : —

Lettuce, White Tennis Ball, one row.
Spinach, Long Standing and Bloomingdale, one row each.
Beets, Egyptian and Dewings, one row each, or two of a kind.
Celery, White Plume, one row.
Kohlrabi, two rows.
Cabbage, Red Dutch and several white varieties, three rows in all.
Tomatoes, Boston Market, two rows.
Potatoes, Beauty of Hebron, five rows.

The details of the results are recorded in our ninth annual report. Being the first year's observation, no serious attempt was made to account for the differences in the yield upon different plats.

1892. — During the spring of 1892 it was thought best to make such alteration in the location of the plats as would secure as far as practicable a corresponding level position for all of them, and thereby remove the objection of the possible influence of a more or less inclined position and different state of moisture of one or the other on the results.

For this purpose the entire width of Field C on its western termination was selected for the future trial. The field thus marked out covered an area 189 feet long and 164 feet wide. It was subdivided into six plats of equal size and shape (88 by 62 feet), corresponding thus in this particular with those in the preceding year. Three plats of the previous year, 3, 4 and 5, remained unchanged; their numbers were altered into 6, 5 and 4. The new plats were numbered 1, 2, 3, beginning at the west end of the field. The entire area was ploughed April 19, and subsequently staked out as above stated into six plats, with four feet unoccupied space between them. The below specified fertilizer mixture was applied to each plat broadcast, and the soil subsequently harrowed. On May 10 it was rolled. All the crops were planted in rows two and one-half feet apart; the different crops were seeded or planted each on the same day in all the plats. The crops were arranged in all plats in the same order, which, in the interest of a desirable rotation, differed from that in the preceding year (plats 4, 5, 6).

Plats.		Annual Supply of Manurial Substances.	Pounds.
Plat 1,	*First Year.*	Sulphate of ammonia,	38
		Muriate of potash,	30
		Dissolved bone-black,	40
Plat 2,		Nitrate of soda,	47
		Muriate of potash,	30
		Dissolved bone-black,	40
Plat 3,		Dried blood,	75
		Muriate of potash,	30
		Dissolved bone-black,	40
Plat 4,	*Second Year.*	Sulphate of ammonia,	38
		Sulphate of potash,	30
		Dissolved bone-black,	40
Plat 5,		Nitrate of soda,	47
		Sulphate of potash.	30
		Dissolved bone-black,	40
Plat 6,		Dried blood,	75
		Sulphate of potash,	30
		Dissolved bone-black,	40

Plats 1, 2 and 3 have been treated with the stated fertilizers this year only; plats 4, 5 and 6 have been treated two years.

The following order in arranging the different crops was adopted in 1892, beginning in each plat at its west end. The rows run in all plats from south to north (88 feet long): —

Two rows of celery, variety Dwarf Golden Heart.
Two rows of lettuce, variety Hanson.
Two rows of spinach, variety New Zealand.
Four rows of beets, variety Edmund's Blood Turnip.
Four rows of cabbages, variety Savoy (one row); variety Fottler's (two rows); variety Red Dutch (one row).
Two rows of tomatoes, variety Essex Hybrid.
Five rows of potatoes, variety Beauty of Hebron.

Potatoes were planted May 9; spinach and beets were sown May 10; lettuce and cabbage plants were set out May 13; tomato plants were set out May 21; celery plants were set out June 9.

The seeds in every case were taken from the same lot; the young plants were raised under corresponding conditions in the same hot-bed, and a corresponding number transplanted in each plat. All plats were kept clean from weeds and treated in a like manner during the season. The crops were harvested whenever fit for the market. The subsequent tabular statements of the yield of the crops show the date of maturity and the quantity obtained at different dates: —

Yield of Celery (Variety Dwarf Golden Heart).

Plats.	Number of Perfect Heads.
Plat 1 (two rows),	46
Plat 2 (one row),	43
Plat 3 (one row),	69
Plat 4 (two rows),	61
Plat 5 (one row),	62
Plat 6 (one row),	52

The plants were set out June 9; they were harvested October 20.

Yield of Lettuce (Variety Hanson).

Plats.	Pounds.
Plat 1 (two rows; seventy heads),	41½
Plat 2 (two rows; seventy heads),	36
Plat 3 (two rows; seventy heads),	43
Plat 4 (two rows; seventy heads),	76
Plat 5 (two rows; seventy heads),	60
Plat 6 (two rows; seventy heads),	36

The plants were set out May 13; they were harvested July 1.

Yield of Spinach (Variety New Zealand).

Plats.	Pounds.
Plat 1 (two rows),	192
Plat 2 (two rows),	233
Plat 3 (two rows),	202
Plat 4 (two rows),	230
Plat 5 (two rows),	232
Plat 6 (two rows),	134

The seed was sown May 10; crop was harvested July 11.

Yield of Beets (Variety Edmund's Blood Turnip).

Plats.	Pounds.
Plat 1 (four rows),	350
Plat 2 (four rows),	345
Plat 3 (four rows),	515
Plat 4 (four rows),	455
Plat 5 (four rows),	509
Plat 6 (four rows),	495

The seed was sown May 10; crop was harvested October 14.

Yield of Cabbages.

PLATS.	Savoy, One Row in Plat.	Fottler's, Two Rows in Plat.	Red Dutch, One Row in Plat.
	Pounds.	Pounds.	Pounds.
Plat 1, ...	100	534	201
Plat 2, ...	113	762	350
Plat 3, ...	116	576½	330
Plat 4, ...	107	458	325
Plat 5, ...	110	674	340
Plat 6, ...	107	586	241

The plants were set out May 13. Savoy cabbages were harvested August 8; Fottler's cabbages were harvested August 12–29; Red Dutch cabbages were harvested September 29; fed to cows and steers.

Each plat contained: —

	Heads.
Savoy cabbages, ...	31
Fottler's cabbages, ...	62
Red Dutch cabbages, ...	31

Yield of Tomatoes (Variety Essex Hybrid).

DATE OF HARVESTING.	PLATS.					
	1	2	3	4	5	6
	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.
August 15, . .	36	43¾	40	36¾	39½	16¼
August 17, . . .	42¼	49	48¾	40¾	48	35¾
August 19, . . .	27¾	39¼	30¾	29¾	38	14¾
August 22, . . .	56	103	51¼	69½	109¼	21½
August 24, . . .	29¼	49	31¾	30¼	45½	7¾
August 29, . . .	19	23	20½	33	33½	15½
August 31, . . .	51¾	54	36¾	63½	51½	39½
September 2, . .	20¾	21	21	21½	14	25½
September 5, . .	40¾	42	45½	42½	44½	38½
September 8, . .	29	30	24	21	34	21
September 10, . .	34½	44	39	57½	39½	26
September 16, . .	56	50	50	55	79	25
September 19, . .	21	19	28	15	18	47
Total, . . .	464	572	466	515	593	332

Seed was obtained of Gregory & Son, Marblehead, Mass. There were two rows in each plat and twenty-two plants in a row. The tomato plants were set out from the hot-bed May 21, came in bloom June 23 and began to form tomatoes July 7.

Yield of Potatoes (Variety Beauty of Hebron).

PLATS.	Pounds.
Plat 1 (five rows), ...	731
Plat 2 (five rows), ...	665
Plat 3 (five rows), ...	545
Plat 4 (five rows), ...	640
Plat 5 (five rows), ...	740
Plat 6 (five rows), ...	435

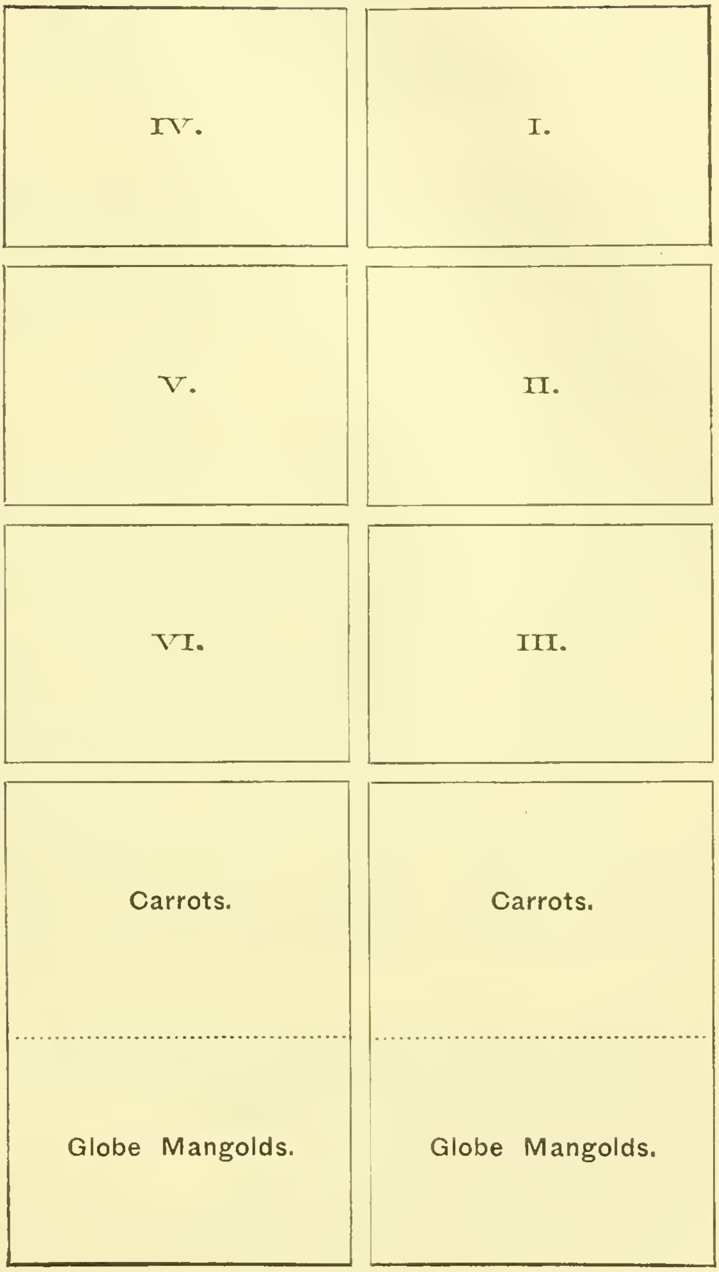
The potatoes were planted May 9; were dug August 17.

Field C, Eastern Portion.

The portion of Field C east of the plats is 183 by 131 feet, and contains .55 acres. The fertilizer applied consisted of 300 pounds of fine-ground bone and 100 pounds of muriate of potash (rate of 600 pounds bone and 200 pounds muriate of potash per acre). It was spread on broadcast May 5, and harrowed in.

The western half of the piece was sown to carrots (variety Danvers) and the eastern half to globe mangolds (variety Yellow Globe) May 14, in drills two and one-half feet apart. May 30 the young plants broke ground. The globe mangolds were harvested October 17; yield, 9,635 pounds (rate of 17 tons 1,680 pounds per acre). The carrots were harvested October 31; yield, 5,545 pounds (rate of 10 tons 530 pounds per acre).

Field "C," 1892.


IV.
I.
V.
II.
VI.
III.
Carrots.
Carrots.
Globe Mangolds.
Globe Mangolds.

Scale, 4 rods to 1 inch.

4. EXPERIMENTS WITH A VARIETY OF NEW FORAGE CROPS (1892).

Field D.

This field is 328 feet long and 70 feet wide (east to west); it covers an area of 22,960 square feet, or .527 acres. During previous years it has been used for the cultivation of a variety of annual farm and garden crops, and has been manured most of the time annually with a mixture of muriate of potash and ground bone, at the rate of two hundred pounds of the former and six hundred pounds of the latter per acre.

During the past season it has served for the raising of a variety of reputed annual and perennial fodder crops, in the majority of cases new to our section of the country, for the purpose of studying their adaptation to our climate and soil.

The field was ploughed April 19, and manured with three hundred pounds ground bone and one hundred pounds muriate of potash. It was harrowed and prepared for planting May 10. The different crops were planted in rows two and one-half feet apart, to admit of the use of a horse cultivator; all were subsequently kept clean by means of the cultivator and hoe. They were arranged in the field in the following order, beginning at the west end of the field: —

Artichoke, Jerusalem (*Helianthus tuberosus*).
Prickley comfrey (*Symphytum officinale*).
Pyrethrum (*Pyrethrum roseum*).
Forest pea (*Lathyrus sylvestris*).
Stachy's tubers (*Stachys affinis*).
Kidney vetch (*Anthyllis vulneraria*).
Winter rape (*Brassica Napus*).
Sainfoin (*Onobrychis sativa*).
Yellow trefoil (*Trifolium agrarium*).
Spring vetch (*Vicia sativa*).
Bokhara clover (*Melilotus alba*).
Summer rape (*Brassica Napus*).
Common English horse bean (*Vicia faba*).
Serradella (*Ornithopus sativus*).
Soja bean (*Soja hispida*).

Cow-pea (*Dolichos sinensis*).
Jackson wonder bean.
Blue lupine (*Lupinus cæruleus*).
White lupine (*Lupinus alba*).
Yellow lupine (*Lupinus lutens*).
Silver-hull buckwheat (*Fagopyrum esculentum*).
Japanese buckwheat (*Fagopyrum esculentum*).
Common buckwheat (*Fagopyrum esculentum*).

Artichoke, ten rows. The tubers for seed were presented by Mr. J. J. H. Gregory of Marblehead, Mass., with the request to ascertain the value of the plants as a forage crop. They were planted May 4, two feet apart in the row. The young plants appeared above the ground May 18; they began to bloom September 23, and suffered from frost October 10 (temperature 28.5° F.). The tubers were dug during the first week of November; yield, six hundred and fifty-nine pounds (rate of eight tons four hundred pounds to the acre). Some of the blooming stalks with leaves were cut and packed into suitable boxes, to ascertain their fitness for ensilage. Analyses of tubers and ensilage will be published later on.

Prickley comfrey (*Symphytum officinale*), one row. The roots used for seed were from last year's growth, in Field C. They were planted May 4. The young plants came up May 18, and bloomed June 8. The plants were cut July 8, when they were thirty inches high, and presented a rank growth of leaf and stem.

Forest pea (*Lathyrus sylvestris*), three rows. The plants used were from last year's growth, in Field C. They were transplanted May 4 and came up May 21; they reached a height of fifteen inches. The roots were remarkable in size. They were nearly two feet in length; large tubercles were quite prominent.

Stachy's tubers (*Stachys affinis*), two rows. This is the second year this plant has been raised on the station grounds. The seed tubers of last year were obtained from the United States Department of Agriculture; those of this year were from our own raising. They wintered well and were vigorous in the spring. They were planted May 4. May 18 the young plants appeared above ground. October

2 the foliage was injured by frost (temperature 33° F.). The tubers produced were scarcely one-eighth of an inch in diameter.

Kidney vetch, four rows. The seed was obtained of Henry Nungesser, New York City. One pound of seed was used, which was sown May 18. The plants came up June 1. The growth was slow, scarcely measuring three inches in the fall.

Winter rape (*Brassica Napus*), five rows. The seed was obtained of D. Landreth & Sons, Philadelphia, Pa. This plant is used quite extensively as a green fodder in sheep-growing districts. The seed was sown May 18, and June 1 the young plants appeared above ground. The growth was heavy, reaching a height of twenty inches. August 6 the crop was cut for fodder.

Sainfoin (*Onobrychis sativa*), five rows. The seed was sown May 18. The young plants appeared above ground June 1. The growth was rather slight, measuring in the fall only ten inches. The plants failed to develop blossoms. The seed was bought of Henry Nungesser, New York City, at six cents per pound.

Yellow trefoil, five rows. The seed was sown May 18. The young plants broke ground June 1. The growth was slow, reaching a height of only three inches. The plants failed to bloom. The seed was obtained of Henry Nungesser, New York City, at eleven cents per pound.

Spring vetch (*Vicia sativa*), five rows. The seed was sown May 18. The plants came up June 1, began to blossom July 11 and to form pods August 1. The growth was cut August 5, having attained a height of twenty-seven inches. The seed was obtained of J. M. Thorburn, New York City, at four and one-half cents per pound. This valuable fodder plant has served us for several years as green fodder in connection with oats.

Bokhara clover (*Melilotus alba*), five rows. The seed was sown May 18. The plants appeared above ground June 1. The leaf development was rather light. October 7 the plants were cut, having reached a height of twenty-eight inches. The seed was obtained of H. Nungesser, New York City, at twenty cents per pound.

Summer rape (*Brassica Napus*), five rows. The seed was sown May 18. The plants appeared above ground June 1. The character of the growth was very much the same as that of winter rape, described above. Four rows were cut for fodder August 6; the remaining row was left to develop farther, but was finally cut, the plants failing to blossom. The seed was obtained of D. Landreth & Sons, Philadelphia, Pa.

Common English horse bean (*Vicia Faba*), five rows. The seed was sown May 18. The plants broke ground June 1, bloomed July 5 and began to develop pods August 6. The growth was characterized by large, coarse stalks and small leaf development. Height of plants September 7 was forty-two inches. The seed was obtained of J. M. Thorburn, New York City, at nine cents per pound.

Serradella (*Ornithopus sativus*), five rows. The seed was sown May 18. The young plants appeared above ground June 1 and came in bloom July 21. The growth was heavy and of good quality. This crop furnishes an excellent green fodder. We have raised it this year at the rate of twelve tons to the acre. A silo has been filled with a mixture of serradella and Hungarian grass (3 : 1), which will be reported upon in the future. The serradella seed was obtained of H. Nungesser, New York City, at eight cents per pound.

Soja bean (*Soja hispida*), five rows. The seed was sown May 18. The young plants appeared above ground June 1 and began to bloom September 22. The growth was very good, reaching a height of about three feet, but was very light colored. October 2 the foliage was injured by frost (temperature, 33° F.). The seed was bought of J. M. Thorburn, New York City, at eight cents per pound.

Cow-pea (*Dolichos sinensis*), five and one-half rows. The seed was sown May 18. The plants broke ground June 1, came in bloom August 23 and began to form pods September 22. The plants were injured by frost October 2 (temperature, 33° F.). The seed was obtained of D. Landreth & Sons, Philadelphia, Pa.

Jackson wonder bean, one-half row. The seed was sent on for trial by the M. W. Johnson Seed Company, Atlanta, Ga. It was sown May 18. The young plants appeared above ground June 1, blossomed during the middle of July and began to form pods August 6. The growth resembled very much the common pole bean.

Blue lupine (*Lupinus cœruleus*), five rows. The seed was sown May 18. The young plants appeared above ground June 1, blossomed July 19 and began to develop pods July 27. The growth was heavy, reaching a height of thirty-eight inches July 25. August 30 the plants were cut for seed. The lupines are considered an excellent crop for green manuring. The seed was bought of J. M. Thorburn, New York City, at fifteen cents per pound.

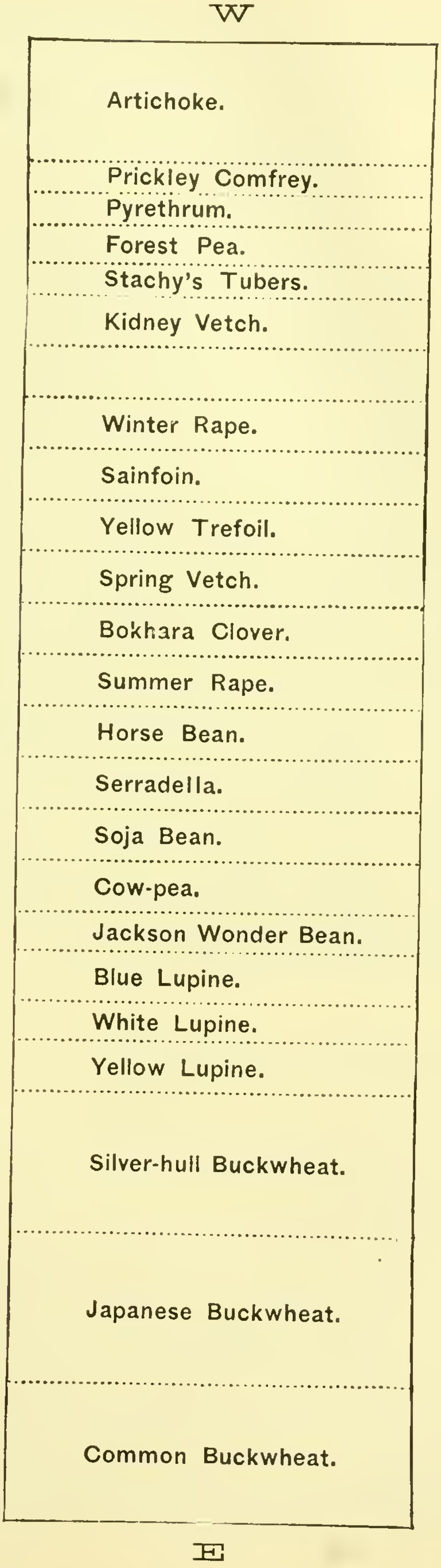
White lupine (*Lupinus alba*), three rows. The seed was sown May 18 and came up June 1. July 7 the plants began to bloom, and August 1 pods were forming. The growth attained a height of thirty-three inches, being somewhat lighter than that of the blue lupine. August 22 the plants were cut for seed. The seed was bought of J. M. Thorburn, New York City, at eleven cents per pound.

Yellow lupine (*Lupinus lutens*), five rows. The seed was sown May 18. The plants broke ground June 1, came in bloom July 21 and began to form pods August 1. This lupine shows the lightest growth of the three, reaching a height of twenty-four inches. Seed was bought of H. Nungesser, New York City, at seven cents per pound.

Silver-hull buckwheat, twelve rows. Seed was sown May 18, came up May 28. The plants made a rapid and heavy growth, measuring, July 7, thirty-four inches. They began to bloom June 25 and were cut for fodder July 11. The seed was obtained of J. M. Thorburn, New York City, at six and one-fourth cents per pound.

Japanese buckwheat, twelve rows. The seed was sown May 18, came up May 28. The plants began to bloom June 30 and were cut for fodder July 11; average height, thirty inches. Seed was obtained of J. M. Thorburn, at six and one-fourth cents per pound.

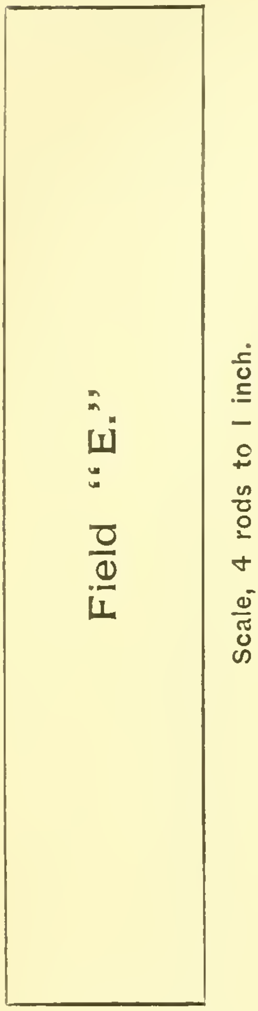
Common buckwheat (*Fagopyrum esculentum*), eleven rows. The seed was sown May 18. The young plants appeared above ground May 28, began to bloom June 23 and were cut for fodder July 11; average height, thirty-six inches. The seed was bought of J. M. Thorburn, at six and one fourth cents per pound.


W
Artichoke.
Prickley Comfrey.
Pyrethrum.
Forest Pea.
Stachy's Tubers.
Kidney Vetch.
Winter Rape.
Sainfoin.
Yellow Trefoil.
Spring Vetch.
Bokhara Clover.
Summer Rape.
Horse Bean.
Serradella.
Soja Bean.
Cow-pea.
Jackson Wonder Bean.
Blue Lupine.
White Lupine.
Yellow Lupine.
Silver-hull Buckwheat.
Japanese Buckwheat.
Common Buckwheat.
E

Field "D," 1892.

Scale, 50 feet to 1 inch.

Field E (Potatoes).



This field is 260 feet long and 48 feet wide ; it contains .286 acres. The field was ploughed April 20. The following fertilizer was applied April 27 : 250 pounds fine-ground bone, 75 pounds sulphate of potash, high grade, ninety-five per cent. (rate of 600 pounds bone, 200 pounds sulphate of potash, high grade, per acre approximately).

At the northern part of the field were a few rows of violets under the care of Professor Humphrey. The remainder of the field (.26 acres) was planted to potatoes (variety Beauty of Hebron), April 30, in rows two and one-half feet apart. Seven bushels of seed were used. On account of the cold weather the potato plants did not appear above ground until May 28. August 4 the potato tops began to die, and August 15 the tubers were dug. They were more or less scabby and rather poor in quality ; total yield 2,775 pounds (10,673 pounds, or 212 bushels, to the acre).

5. FIELD EXPERIMENTS WITH DIFFERENT COMMERCIAL PHOSPHATES TO STUDY THE ECONOMY OF USING THE CHEAPER NATURAL PHOSPHATES OR THE MORE COSTLY ACIDULATED PHOSPHATES.

Field F.

The field selected for this purpose is 300 feet long and 137 feet wide, running on a level from east to west. Previous to 1887 it was used as a meadow, which was well worn out at that time, yielding but a scanty crop of English hay. During the autumn of 1887 the sod was turned under and left in that state over winter. It was decided to prepare the field for special experiments with phosphoric acid by a systematic exhaustion of its inherent resources of plant food. For this reason no manurial matter of any description was applied during the years 1887, 1888 and 1889.

The soil, a fair sandy loam, was carefully prepared every year by ploughing during the fall and in the spring, to improve its mechanical condition to the full extent of existing circumstances. During the same period a crop was raised every year. These crops were selected, as far as practicable, with a view to exhaust the supply of phosphoric acid in particular. Corn, Hungarian grass and leguminous crops (cow-pea, vetch and serradella) followed each other in the order stated.

1890. — The field was subdivided into five plats, running from east to west, each twenty-one feet wide, with a space of eight feet between adjoining plats.

The manurial material applied to each of these five plats contained, in every instance, the same form and the same quantity of potassium and of nitrogen, while the phosphoric acid was furnished in each case in the form of a different commercial phosphoric-acid-containing article; namely, phosphatic slag, Mona guano, Florida phosphate, South Carolina phosphate (floats) and dissolved bone-black. The market cost of each of these articles controlled the quantity applied, for each plat received the same money value in its particular kind of phosphate.

Cost per Ton.

Phosphatic slag,	$15 00
Mona guano (West Indies),	15 00
Florida rock phosphate,	15 00
South Carolina phosphate (floats),	15 00
Dissolved bone-black,	25 00

Analyses of Phosphates used.

[I., phosphatic slag; II., Mona guano; III., Florida phosphate; IV., South Carolina phosphate; V., dissolved bone-black.]

	PER CENT.				
	I.	II.	III.	IV.	V.
Moisture,	0.47	12.52	2.53	0.39	15.96
Ash,	–	75.99	89.52	–	61.46
Calcium oxide,	46.47	37.49	17.89	46.76	–
Magnesium oxide,	5.05	–	–	–	–
Ferric and aluminic oxides,	14.35	–	14.25	5.78	–
Total phosphoric acid,	19.04	21.88	21.72	27.57	15.82
Soluble phosphoric acid,	–	0.00	–	0.00	12.65
Reverted phosphoric acid,	–	7.55	–	4.27	2.52
Insoluble phosphoric acid,	–	14.33	–	23.30	0.65
Insoluble matter,	4.39	2.45	30.50	9.04	6.26

In 1890 potatoes were raised on the plats; in 1891 winter wheat was the crop experimented with (for details see ninth annual report). The following fertilizing mixtures have been applied annually to all plats, with the exception of Plat 3, which received in 1890 ground apatite and in 1891 no phosphate whatever: —

PLATS.	Annual Supply of Manurial Substances.	Pounds.
Plat 1 (south, 6,494 square feet),	Ground phosphatic slag,	127
	Nitrate of soda,	43
	Potash-magnesia sulphate,	58
Plat 2 (6,565 square feet),	Ground Mona guano,	128
	Nitrate of soda,	43½
	Potash-magnesia sulphate,	59
Plat 3 (6,636 square feet),	Ground Florida phosphate,	129
	Nitrate of soda,	44
	Potash-magnesia sulphate,	59
Plat 4 (6,707 square feet),	South Carolina phosphate,	131
	Nitrate of soda,	44½
	Potash-magnesia sulphate,	60
Plat 5 (6,778 square feet),	Dissolved bone-black,	78
	Nitrate of soda,	45
	Potash-magnesia sulphate,	61

The phosphatic slag, Mona guano, South Carolina phosphate and Florida phosphate were applied at the rate of 850 pounds per acre; dissolved bone-black at the rate of 500 pounds per acre. Nitrate of soda was applied at the rate of 290 pounds to the acre, and potash-magnesia sulphate at the rate of 390 pounds per acre.

1892. — The field was sown to serradella May 17, in drills two and one-half feet apart; thirty-two pounds of seed were used for the entire piece. The seed was bought of Henry Nungesser, New York City, at eight cents per pound. May 28 the young plants appeared above ground and were quite uniform in all the plats. July 20 the serradella came in bloom, the average height being five inches. The growth was slow at first, but during the hot days of August it made rapid strides, and at the time of cutting (September 9, 10) the plants measured on an average thirty-one inches in length, and covered the ground with a complete mat of foliage. The serradella was cut, at the time stated above, while perfectly green, and packed in a silo with Hungarian grass. Following is a statement of the yield of the several plats: —

PLATS.	Weight of Green Serradella (Moisture, 82.03 Per Cent.).	Yield per Acre.
	Pounds.	Tons.
Plat 1,	4,070	13.69
Plat 2,	3,410	11.29
Plat 3,	2,750	9.05
Plat 4,	3,110	10.10
Plat 5,	2,920	9.36

Analysis of Serradella (Green).

[Station, Field F, 1892.]

	Per Cent.
Moisture at 100° C.,	82.03
Dry matter,	17.97
	100.00

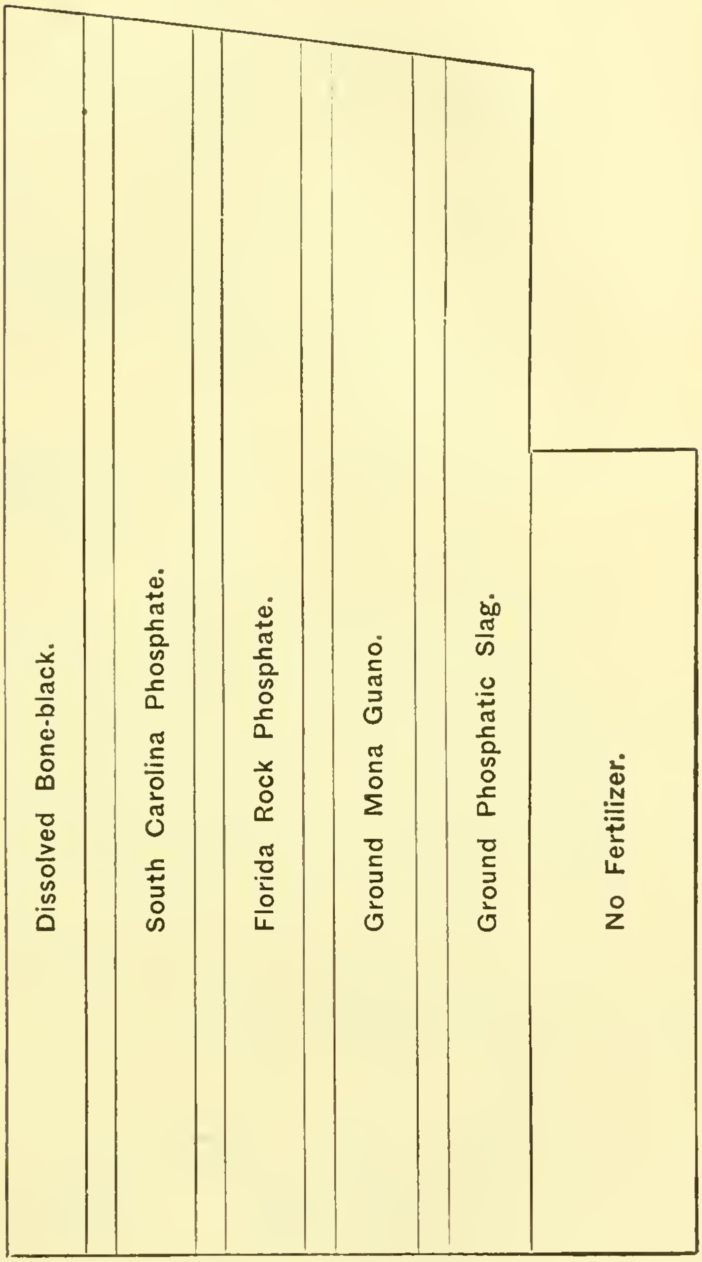
Analysis of Dry Matter.

	Per Cent.
Crude ash,	9.59
" cellulose,	26.28
" fat,	2.59
" protein,	15.13
Non-nitrogenous extract matter,	46.41
	100.00

Fertilizing Constituents.

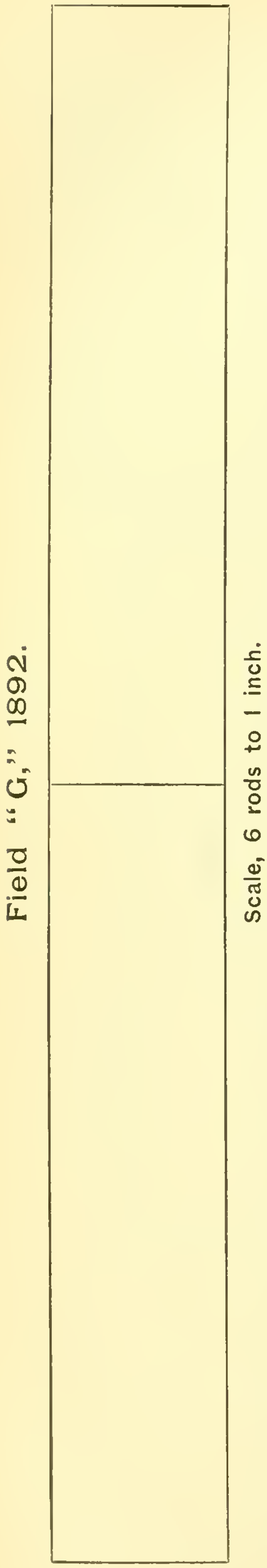
Moisture,	82.03
Nitrogen,	0.435
Phosphoric acid,	0.126
Potassium oxide,	0.379
Valuation per 2,000 pounds,	$1 78

Field "F," 1892.


Dissolved Bone-black.
South Carolina Phosphate.
Florida Rock Phosphate.
Ground Mona Guano.
Ground Phosphatic Slag.
No Fertilizer.

Serradella.

Scale, 4 rods to 1 inch.



6. EXPERIMENT WITH VETCH AND OATS FOR GREEN FODDER AND HAY (1892).

Field G.

This field is 700 feet long and 75 feet wide; area, 52,500 square feet, or 1⅕ acres. The land is nearly level and the soil a loam several feet in depth. No manurial matter has been applied since 1890, the object being to reduce the stored-up plant food, and thereby prepare the soil for future field experiments with special fertilizers.

The field was ploughed April 18, and subsequently thoroughly harrowed. The northern half of the field was sown to vetch and oats April 21. Two bushels of oats and thirty-five pounds of spring vetch were used for seed. The southern half of the field was sown June 1, four bushels of oats and thirty-five pounds of spring vetch being used for seed. The plants came up May 3 on the northern half and June 6 on the southern half of the field.

We commenced cutting the crop for green fodder June 28, when the vetch was beginning to bloom and the oats to head out, beginning at the north end. The portion of the northern half cut over in this manner was 109 by 75 feet, or 8,175 square feet. The yield was 3,020 pounds (rate of 8 tons to the acre). The remainder of this half was cut and dried for hay. Yield of well-dried hay, 1,195 pounds (rate of 2,900 pounds to acre). The cutting of the southern half of the field was commenced July 12. The total yield of green fodder amounted to 3 tons 1,148 pounds (rate of 5 tons 1,900 pounds to the acre).

The analysis of vetch and oats will be found below: —

Vetch and Oats (Green).

	Per Cent.
Moisture at 100° C.,	82.02
Dry matter,	17.98
	100.00

Analysis of Dry Matter.

Crude ash,	9.31
" cellulose,	29.80
" fat,	2.79
" protein,	16.77
Non-nitrogenous extract matter,	41.33
	100.00

Fertilizing Constituents.

Moisture,	82.02
Nitrogen,	0.482
Phosphoric acid,	0.132
Potassium oxide,	0.418
Valuation per 2,000 pounds,	$1 97

Canada Peas and Oats.

[Young orchard, east fields.]

The area occupied by this crop was one acre approximately. The seed was sown broadcast April 29, 1892, two bushels of Canada peas and four bushels of oats being used. The peas were slightly ploughed in and the oats harrowed in. The young plants appeared above ground May 6, and made a rapid and luxuriant growth. Began to cut the crop for green fodder June 13, when the peas were coming in bloom. The plants attained a height of nearly three feet, and yielded five and one-half tons per acre of green fodder of the following composition: —

Analysis of Canada Peas and Oats (Green).

[Station, 1892.]

	Per Cent.
Moisture at 100° C.,	86.32
Dry matter,	13.68
	100.00

Analysis of Dry Matter.

Crude ash,	6.90
" cellulose,	26.66
" fat,	2.29
" protein,	16.01
Non-nitrogenous extract matter,	48.14
	100.00

7. EXPERIMENTS WITH GRASS LAND (MEADOWS).

The permanent grass lands are by their location arranged into two divisions, west and east of a public highway. They cover at present a space of sixteen to seventeen acres.

The *west side division* consists of old meadows, kept for over twenty years in grass. The area has for years been steadily reduced in size by turning, as circumstances advised, more or less at a time into plats for field experiments. In their present condition they surround our main field for experimental purposes. They are in part underdrained, and are kept, by a moderate annual top-dressing with barnyard manure, in a fair state of production, considering the condition of the sod. The area comprises to-day approximately not more than seven acres.

The *east side division* of meadows comprises an area of about 9.6 acres. The entire field to 1886 consisted of old, worn-out grass lands, overrun with a worthless growth on its more elevated portion, and covered with weeds and sedges in its lower section. The improvement of the land by underdraining and ploughing, and subsequently by the use of a system of drill culture, began in some parts (north end) in 1886 and in others (south end) in 1887. For the details of this work see ninth annual report (1891). The following seeds have been applied: —

In 1888, to the more elevated portions —

Two bushels herds grass (*Phleum pratense*).
Two bushels red top (*Agrostis vulgaris*).
Two bushels Kentucky blue-grass (*Poa pratensis*).
Two bushels meadow fescue (*Festuca pratensis*).
Seven pounds sweet-scented vernal grass (*Anthoxanthum odoratum*).

This was applied at the rate of from two to two and one-half bushels per acre. The lower and more wet portion of the meadow was seeded down with the following mixture of grass seeds: —

Twenty pounds soft brome grass (*Bromus mollis*).
Twelve pounds herds grass (*Phleum pratense*).
Nine pounds red fescue (*Festuca rubra*).
Eight pounds fowl meadow grass (*Poa serotina*).
Seven pounds Rhode Island bent (*Agrostis alba*).
Six pounds orchard grass (*Dactylis glomerata*).
Five pounds crested dog-tail (*Cynosurus cristatus*).
Four pounds meadow soft grass (*Holcus lanatus*).
Two pounds sweet-scented vernal grass (*Anthoxanthum odoratum*).

In 1889, from four to five pounds of alsike clover per acre were added by broadcast seeding to the meadow early in the spring.

In 1890, from two to three pounds of alsike clover seed were sown per acre on the entire meadow.

In 1892 the entire area was divided into four plats, numbered I., II., III., IV., beginning at the north end. The following system of manuring was adopted: —

Plat I. (1.95 acres), 31,200 pounds barn-yard manure, applied late in the fall of 1891 (rate of 8 tons to the acre).

Plat II. (2.02 acres), 24,240 pounds barn-yard manure, applied March 4, 1892 (rate of 6 tons to the acre).

Plate III. (2.59 acres), 1,554 pounds ground bone, 518 pounds muriate of potash, applied April 18, 1892 (rate of 600 pounds bone and 200 pounds muriate of potash per acre).

Plat IV. (3 acres), 3 tons unleached wood ashes, applied April 15, 1892 (rate of 1 ton to the acre).

Following is the yield of hay (first and second cut) for three consecutive years: —

Yield of Hay in 1890.

PLAT I.	First Cut.	Second Cut.
1.92 acres, . .	14,625 pounds, July 1.	3,790 pounds, Sept. 1.

Total yield of hay, 18,415 pounds.
Yield per acre, 9,591 pounds, or 4.80 tons.

Yield of Hay in 1890 — Concluded.

PLAT II.	First Cut.	Second Cut.
1.92 acres, . .	12,480 pounds, July 1.	3,105 pounds, Sept. 3.

Total yield of hay, 15,585 pounds
Yield per acre, 8,117 pounds, or 4.06 tons.

PLAT III.	First Cut.	Second Cut.
2.41 acres, . .	14,460 pounds, June 26.	3,535 pounds, September.

Total yield of hay, 17,995 pounds.
Yield per acre, 7,466 pounds, or 3.73 tons.

PLAT IV. (IV. and V., **1889.**)	First Cut.	Second Cut.
3 acres, . . .	13,380 pounds, July 1.	4,080 pounds, Sept. 3.

Total yield of hay, 17,460 pounds.
Yield per acre, 5,820 pounds, or 2.91 tons.

Yield of Hay in 1891.

PLATS.	First Cut.	Second Cut.	Total.
	Pounds.	Pounds.	Pounds.
Plat I., per acre, ...	6,528	1,446	7,974
Plat II., per acre, ...	5,988	1,440	7,428
Plat III., per acre, ...	4,641	1,015	5,656
Plat IV., per acre, ...	3,750	1,610	5,360

Yield of Hay in 1891 — Concluded.

PLATS.	TOTAL YIELD.		TOTAL YIELD PER ACRE.	
	Tons.	Pounds.	Tons.	Pounds.
Plat I.,	7	1,549	3	1,974
Plat II.,	7	1,004	3	1,428
Plat III.,	7	649	2	1,656
Plat IV.,	8	80	2	1,360

Yield of Hay in 1892.

PLATS.	FIRST CUT.				SECOND CUT.			
	TOTAL WEIGHT.		RATE PER ACRE.		TOTAL WEIGHT.		RATE PER ACRE.	
	Tons.	Pounds.	Tons.	Pounds.	Tons.	Pounds.	Tons.	Pounds.
Plat I.,	5	805	2	1,541	2	45	1	74
Plat II.,	5	895	2	1,394	1	1,975	–	1,968
Plat III.,	6	50	2	652	1	1,320	–	1,282
Plat IV.,	6	1,087	2	362	3	110	1	36

PLATS.	TOTAL YIELD.		TOTAL YIELD PER ACRE.	
	Tons.	Pounds.	Tons.	Pounds.
Plat I.,	7	850	3	1,615
Plat II.,	7	870	3	1,362
Plat III.,	7	1,370	2	1,934
Plat IV.,	9	1,197	3	398

Yield of Hay on West Side Division.

	Tons.	Pounds.
First cut,	9	510
Second cut,	3	25

Following is the analysis of hay and rowen grown on the plats : —

[I., hay; II., rowen.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	8.94	11.31
Dry matter,	91.06	88.69
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	6.64	6.48
" cellulose,	34.82	29.98
" fat,	3.18	4.23
" protein,	10.41	12.11
Non-nitrogenous extract matter,	44.95	47.20
	100.00	100.00

Fertilizing Constituents.

Moisture,	8.94	11.31
Nitrogen,	1.516	1.717
Phosphoric acid,	0.269*	0.432*
Potassium oxide,	1.55*	1.486*
Valuation per 2,000 pounds,	$6 24	$6 96

* Average in ninth report.

8. Report on General Farm Work (1892).

The lands assigned for the use of the Massachusetts State Agricultural Experiment Station cover an area of fifty acres. Ten acres are natural woodlands, and forty acres, including the space occupied by the buildings, are used for the raising of farm crops. At present from fifteen to sixteen acres are under cultivation, and from sixteen to seventeen acres are permanent grass lands. As every portion of the land is at present serving for some special experiment, the general management of the farm is to a controlling degree subjected to the requirements of the work called for in connection with the various questions under investigation. The adoption of a thorough mechanical preparation of the soil, supported by a careful, clean cultivation of the crops raised, has brought the lands into a fair condition for field experiments. Each field has had for years its own system of manuring, and becomes thereby from year to year more valuable for experimental purposes. Wherever circumstances have been favorable, forage crops have been chosen, for the purpose of studying the influence of various systems of fertilization and cultivation on their growth and special character. This practice has resulted already in the successful introduction of some valuable forage plants new to our locality, and has also materially assisted us in an economical support of quite extensive experiments in stock feeding. The beneficial effect of many of these crops on the physical and chemical condition of our cultivated lands is everywhere noticed, when compared with their previous general condition.

During the past season several varieties of soja bean, serradella, Canada peas and oats, summer vetch and oats have been raised, to supplement our current farm crops, as corn, rye, barley, Hungarian grass, etc., for feeding purposes.

Three silos have been filled with mixtures of different crops; one silo is filled with equal weights of fodder corn and soja bean, one with two parts soja bean and one part fodder corn, and the third with three parts serradella and one part Hungarian grass.

The character and amount of farm and garden crops raised in 1892 may be seen from the subsequent statement: —

	Tons.
Hay (first cut),	35
Rowen (second cut),	$11\frac{3}{4}$
Fodder corn (green),	$17\frac{1}{2}$
Corn stover,	$4\frac{3}{4}$
Corn (ears),	$\frac{3}{4}$
Roots (beets, $1\frac{1}{3}$; mangolds, $4\frac{3}{4}$; carrots, $2\frac{3}{4}$; turnips, $\frac{1}{4}$),	9
Rye (643 pounds grain, 1,767 pounds straw),	$1\frac{1}{5}$
Barley (539 pounds grain, 1,289 pounds straw),	$\frac{9}{10}$
Oats (318 pounds grain, 1,227 pounds straw),	$\frac{3}{4}$
Potatoes,	$3\frac{1}{5}$
Tomatoes,	$1\frac{1}{2}$
Cabbages,	3
Vetch and oats (green),	5
Vetch and oats (dry),	$\frac{1}{2}$
Soja bean (green),	10
Soja bean (straw, 770 pounds; beans, 240 pounds),	$\frac{1}{2}$
Canada peas and oats (green),	$1\frac{3}{4}$
Canada peas and oats (dry),	$\frac{3}{4}$
Miscellaneous crops,	$2\frac{1}{2}$

9. DEPARTMENT OF VEGETABLE PHYSIOLOGY.

REPORT BY DR. JAMES ELLIS HUMPHREY.

As in previous years, the work of the department has steadily continued since the last report. The results of the year's investigations to be described in the following pages contain several matters of scientific interest and of practical importance to various classes of cultivators. The work on diseases of some leading winter crops has been continued, and a considerable part of the present report is occupied by a discussion of the known fungous diseases of the cucumber plant, both under glass and in the open air. Studies of a disease of English violets are described; as also some cultures of the "black-knot" fungus of the plum, with suggestions for its practical control. Directions for avoiding the attacks of the fungi known as powdery mildews will also be found, and briefer notes on other disease-producing fungi of importance.

The department has replied, during the year, to numerous inquiries from various sources touching a wide range of subjects, and has been able to be of considerable service to the farmers and gardeners of the State in this way.

In closing his connection with the station with the completion of this report, the writer desires to express the hope that the value of mycological investigations has been sufficiently demonstrated to ensure their continuation at Amherst.

The subject-matter of the present report is arranged under the following heads: —

I. Diseases of the cucumber plant.
    1. Sclerotium disease ("timber rot").
    2. Powdery mildew.
    3. Downy mildew.
    4. Damping off.
    5. Leaf blight.
    6. Leaf glaze.
    7. Other diseases

II. A violet disease.
III. The black knot of plum and cherry.
IV. Grain rusts.
V. Various diseases.
  1. Powdery mildew of strawberry.
  2. Powdery mildew of gooseberry.
  3. Cluster cup of gooseberry.
  4. A hazel fungus.
VI. Treatment for powdery mildews.

As before, the "General Account of the Fungi," on pages 195 to 211 of the seventh report of this station, may be found useful as an aid to the full understanding of the following discussions.

I. DISEASES OF THE CUCUMBER PLANT.

1. A SCLEROTIUM DISEASE. — *Sclerotinia Libertiana* F'k'l (Plates I. and II.)

A subject concerning which many and urgent inquiries have been addressed to the writer by growers of winter cucumbers near Boston is the disease known among them as "timber rot."* This trouble makes its appearance regularly in the spring, when the plants are well grown and in bearing, and is a cause of much loss. The first specimens showing the nature and effects of the disease were received in May last, from W. W. Rawson, Esq., of Arlington; and subsequently a visit was made to his greenhouses, where the disease was seen in various stages of development, and further specimens for study were obtained.

The most cursory examination of good specimens makes it evident that we have here to do with a fungous disease of much interest. It attacks chiefly the stems of the host-plants, sometimes the fruits. I am not aware that it ever attacks this crop out of doors, but in the warm and moist atmosphere of the cucumber house the fungus finds very congenial conditions for luxuriant development. The earliest external sign of the presence of the fungus to which the disease is due is commonly the appearance of dense white mats of its mycelium at and near the nodes of the stem (Pl. I., *a*). Examination shows that the tissues of the stem are thoroughly permeated by the fungus-threads, which have here burst through the surface. At this stage the stem is still green and plump (Pl. I., *a*), but as the disease progresses it begins to shrink (Pl. I., *b*) and to turn yellow. Later, its cellular tissue (parenchyma) undergoes what may be termed a sort of granular decay, shrivels, and finally dries up, leaving hardly more than a withered mummy of the original stem, consisting of the dried and yellow vascular bundles and epidermis (Pl. I., *c*).

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* Concerning the origin of this name it is not easy to suggest an explanation. Popular names of diseases serious enough to attract attention are usually in some way descriptive or otherwise appropriate. The present name has little of such quality to recommend it, and I have no clue to its origin, unless the appearance of the fresh mycelial threads on the stem may have suggested that of the mycelium of *Merulius lachrymans* and other hymenomycetous species which attack wood.

In the interior of diseased stems may be found thick masses of white mycelium, and in the later stages there appear, especially near the nodes, hard, slender black bodies, sometimes of considerable size, which remain after the disappearance of the mycelium (Pl. II., fig. 1). These serve as a clue to the cause of the disease when only the dried skeleton of the stem remains. Sometimes similar black bodies are developed in the mycelial mats on the exterior of the stems (Pl. I., *d*), but this is not commonly the case. Where it does occur, these bodies, instead of being slender and spindle-shaped, are usually rounded or irregular in outline, and more or less flattened. In either form they are at once recognizable as the characteristic resting stage of certain fungi, known as *sclerotia*, and point strongly to the probability that the disease is due to one of the parasitic cup-fungi (*Discomycetes*) of the genus *Sclerotinia*. The young fruits are often attacked by the fungus, becoming soft and watery, and their surfaces being covered by the white mycelium. The rounded and flattened sclerotia are usually quite freely developed on the rotted fruits (Pl. I., *fr.*), and are often found adhering to their shrunken remnants. Sometimes two or more sclerotia of the surface form arise so close together as to become united into an irregular mass (fig. 2).

These sclerotia arise from masses of fungus-threads which become closely intertwined, branching and increasing in size until a compact structure is formed. This is at first white, but its outer layers soon become changed, and their cell walls thickened and blackened to form a protective rind about the inner unchanged parts. A section through the inner portion of a mature sclerotium shows that the constituent threads have become so closely compacted that they form a firm pseudoparenchyma (fig. 6). As they lie in all directions, any section is sure to follow the course of some of the threads, while others are cut at all angles. Thus the apparent cells of the pseudoparenchyma vary in outline from circular to much elongated. The cell cavities have abundant protoplasmic contents, but neither starch nor oil can be recognized in them. When sections are submitted to Errera's iodine test, however, they prove to be very rich in glycogen, which doubtless serves as a reserve food material for the future development of the sclerotia. These bodies are to be regarded, then, as resting mycelia, which serve the same purpose as the resting spores of some fungi in tiding over periods unfavorable to active development, and thus keeping alive the species from season to season.

In order to learn the history of their further development, a number of sclerotia were placed in moist chambers May 26, a part on rather poor soil and a part on pure quartz sand. Both lots were kept about equally damp, and stood side by side in a north window; but those on the sand began their "germination" more promptly and carried it through more satisfactorily. As those on the soil gave no results different from the others, and were subsequently transferred to sand, where they did much better, they will be neglected in the following account. But it should be said that this result was to be expected under the very artificial conditions of the culture chamber, and cannot be held to be equally applicable to the greenhouse. In a month one of the sclerotia on quartz sand showed signs of further development. Two slender stalks were growing upward from its upper side, and two others were just breaking through its lower surface. This would indicate that the points of origin of these stalks are not determined by the amount of light to which they are exposed. The rate of growth of the stalks may be indicated by the fact that two which were five millimeters long June 28 (fig. 3) had become nine millimeters long July 8, ten days later. Two months after the beginning of the culture several sclerotia showed from one to four stalks each, some of them well developed. These stalks are bundles of nearly parallel threads, arising from the inner tissue of the sclerotium and bursting through the rind. They are at first white, except for a short distance above their bases, and their sides are clothed by the short and delicate free ends of some of the outer threads. If they assume an erect position from the first, their basal portions are only slightly dark colored (figs. 3 and 7); but if, as often happens, they grow for a time beneath the surface of the sand or soil, these portions may have hardened and blackened surfaces (fig. 5). These stalks, or their aerial portions, are very sensitive to light. In cultures before a window the young stalks grew from the first strongly toward the window. When the culture chamber was turned through 180°, so as to make them point away from the window, they very promptly responded to the stimulus of the light, and in a single day showed strong heliotropic curvature. In two or at most three days they had bent sharply upon themselves, and were again directing their tips obliquely toward the light, in response to the combined influences of negative geotropism and positive heliotropism. By the time a stalk reaches a length of about five millimeters above the surface of the sclerotium or of the soil, a conical depression begins to appear in its upper end (fig. 7). This depression arises and increases in size by greater growth at the circumference than at the centre of the stalk, and the final result is a shallow cup crowning the stalk. Some idea of the rate of growth of these cups may be gained by comparing the stages *a* and *b* in figs. 4 and 5, in each of which the condition shown at *b* represents the gain in four days over *a*. Under favorable conditions the cups may reach a diameter of as much as eight millimeters, and they have been been even larger. Ordinarily, when they become larger they are also much flattened, having often the form of disks, with only slight depressions at their centres. When mature, their outer surfaces remain of a white or slightly creamy color, while their inner or upper faces are of a brownish or clay-colored shade.

While still very young the cups may be seen to be the spore-producing organs of the fungus. The body of a cup is composed of threads, which are continuations of and similar to those of the stalk; but its inner surface is composed of two kinds of threads, arising from the vegetative threads of the outer portion and standing close together parallel to each other and at right angles to the surface, like the threads of the "pile" of velvet. A part of these threads are essentially similar to those from which they arise, and these terminate in blunt ends. They are known as *paraphyses*. The rest are much swollen, and when young have dense protoplasmic contents. As they reach their full size the contents begin to show differentiation, and there finally appear in each of these spore-sacs eight colorless, elliptical spores (fig. 8). When the spores are quite mature, one may observe that the tip of the spore-sac (*ascus*) appears thickened and gelatinous. It is through this apical part of the wall that the spores are discharged; and after their escape one may see the opening through which they have passed out. The ejection of the spores from an ascus takes place suddenly and explosively, and, as the tips of the asci form the inner surface of the cup, they pass directly into the air. If a cup be allowed to develop quite undisturbed in a moist chamber for two or three days, and then be slightly jarred, the escape of the spores from the numerous asci that have ripened during the interval can be plainly seen, like a tiny puff of white smoke from the surface of the cup. If a glass slip, moistened with water, be held over the cup when this occurs, the spores (fig. 8, *sp.*) can be obtained very pure and in considerable quantity. As has been said, the asci and spores begin to mature when the cup is still very small, and the ripening of successive ones continues during and after the close of the growth of the cup, for a period of three weeks or more. During this time the number of spores produced by a single cup is enormous, and quite beyond approximate estimations. In my cultures of a few sclerotia produced on a single young fruit (Pl. I., *fr.*), they continued to give rise to successive new cups for a period of four months.

A comparison of the structures which have been described with the recorded facts concerning the known *Sclerotiniæ* shows that in the form and structure of the sclerotia, in the color, form and size of the cups, and in the form and size of the spores, this fungus fully agrees with the European species known as *Sclerotinia Libertiana* F'k'l., and described by Brefeld * and DeBary † under the name *Peziza Sclerotiorum.* Our first cultures with this fungus were made immediately after obtaining the material, with the only parts of the plant then available, mycelium taken from diseased cucumber stems, and sclerotia. On prune-gelatine a small bit from a mass of mycelium gave rise to abundant threads, ramifying through the substratum, and producing abundantly the "attachment organs," to be described later, but giving rise neither to sclerotia nor to any spore form. Thin slices from the inner tissue of sclerotia sown on the same substratum gave the same result. But when similar slices were sown on sterilized bread, saturated with an infusion of prunes, the bread became completely enveloped in a white mycelial cloud. A week after the beginning of the culture the mycelium had collapsed into a thick film over the surface of the bread, and a few rather small sclerotia had formed on the surface. Two weeks later, no further change having been observable and all development having evidently ceased some time before, the whole was removed from the moist chamber, and it was found that beneath the superficial mycelial film, and occupying the space originally occupied by the substance of the bread, was an almost solid mass of well-matured sclerotia, varying in size from that of small shot to that of a large pea.

We may consider next the cultures with ascospores made after the development of the spore cups from the sclerotia afforded the means of obtaining them. When these spores are sown in distilled water and protected from drying up, they germinate promptly and show considerable growth by the end of the first day (fig. 9). They may continue to grow for about two days, in which time the germ tube may become several times as long as the greater diameter of the spore. If no nourishment be obtainable, growth ceases and death follows. If, however, nourishment be provided in the form of an infusion of prunes, for instance, the development of the germ thread is very rapid, and the entire culture drop is filled by a mat of strong and branching threads. The difference in development due to absence or presence of nourishment may be seen by comparing figs. 9 and 10, which represent spores after one day's development under these opposite conditions, respectively. Vigorous branches of the mycelium grow upward into the air and downward into contact with the glass slip supporting the culture. No traces of spore formation could ever be detected on the aerial threads, although carefully sought for. On the branches which come in contact with the glass are produced in all nourished cultures, and very abundantly, certain structures characteristic of this and related species of fungi, and known as *attachment organs*. These organs appear to be formed whenever branches of a growing mycelium come in contact with firm unyielding objects. They are produced by the rapid and more or less exactly dichotomous branching of a thread, which, at the same time, becomes much stouter and richer in protoplasmic contents than before. The short and densely aggregated branches form a thick tassel, which becomes attached by the free ends of its branches to the substratum (fig. 11). At this time these organs are readily recognized by the naked eye as small darker spots on the glass of the culture slip or vessel. A day after its complete development one of these organs shows signs of degeneration. Its dense contents begin to become watery and to disappear, and by the second day there is left little but the empty outer walls, enclosing a nearly or quite continuous cavity (fig. 12). The possible or probable significance of these peculiar structures may be discussed later. Slide cultures of spores in prune infusion or similar fluid medium rarely yielded anything besides mycelium and attachment organs; but occasionally a small sclerotium is developed. The vegetative development on any nutrient substratum is accompanied by a remarkable formation of the octahedral crystals of oxalate of lime, which are produced in immense numbers in the interstices between the threads.

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* Botanische Untersuchungen über Schimmelpilze, IV.: 1881.

† Botanische Zeitung, 1886, Nos. 22–27.

Ascospores sown on sterilized bread saturated with an infusion of prunes, in test tubes, produced an abundant and beautiful mycelium over the whole surface of the bread and far above it. The branches in many places reached the inner surface of the tubes, and there developed great numbers of attachment organs. No spore formation ever occurred; but a week after the beginning of the culture dense white masses were detected among the looser threads. On examination these proved to be very firm lumps of matted threads; and the following day they had become nearly black in color. A day later, nine days from the sowing of the spores, the cultures contained many larger and structurally mature sclerotia. In this case the sclerotia were produced wholly upon the surface, and did not replace at all the substance of the bread, as in a previously described instance. Subsequent examination showed that no further development occurred, the activity of the mycelium ceasing with the formation of the sclerotia.

If ascospores be sown in water on the surface of a cucumber stem, or at its growing point, it might be expected that the germ tubes would promptly penetrate the tissues and infect the plant, if it be really true that this fungus is the efficient cause of the disease. But, although carefully protected from drying, they utterly fail to attack the plant, even though sown in a fresh cut reaching to the active tissues of the plant, when sown in water only. On the other hand, if they be sown on a healthy and uninjured part of the plant, in a drop of nutrient fluid, the result is very different. Germination proceeds rapidly, attachment organs are formed on the surface of the plant, and soon this surface is penetrated by fungus-threads which quickly spread through the tissues. In this way infection takes place, and the plant is lost. Even the leaves of a plant kept in a moist chamber are in this way readily attacked. Three days from the sowing of a small drop of prune infusion containing fresh ascospores upon a large leaf of such a plant, the leaf was a slimy mass of decay, while a neighboring one, sown with spores in pure water at the same time, remained perfectly sound. Two days later the whole plant had succumbed. If a bit of decayed tissue, containing abundant and vigorous threads of the fungus, be placed upon a healthy plant, the latter is promptly attacked and destroyed. These results furnish interesting confirmation of DeBary's conclusion* that the spores of this fungus are unable to attack its host-plants parasitically until their germ tubes have been saprophytically nourished for a time. That is, the fungus may be said to be in process of acquiring a truly parasitic habit which it has not yet fully developed. There is no reason to doubt that these spores, germinating on the rich soil of the greenhouse, about the bases of the plants, find there all the nourishment needed for the development of a mycelium capable of parasitic invasion. It seems very probable, too, that DeBary's explanation* of the significance and function of the so-called attachment organs is the correct one. This is to the effect that these organs, developed on the firm surface of the host from the saprophytically nourished mycelium, produce in the fluid which results from the breaking down of their protoplasm, previously described, some substance which softens the cell walls and kills the cell contents of the host. The fungus-threads are then able to attack these dead cells, and thence to penetrate farther and farther into the tissues of the host-plant. After its establishment, and the development of an abundant mycelium within the host, the fungus forms its sclerotia just as in the cultures above described, their form being somewhat modified by the shape of the cavity when they develop in the inner spaces of the plant.

We pass now to consider the question of other spore forms of this fungus. It is a well-known fact that many Ascomycetous fungi possess one or more secondary "summer spore" forms, known as conidia, pycnidia, etc.; and some such forms have been found to belong to those species of fungi most closely related to the present one. None has, however, been heretofore proved to belong to the present species. Therefore, when, in examining plants in Mr. Rawson's greenhouse, a young rotting cucumber was found which bore, besides the white *Sclerotinia* mycelium, the dark spore threads and abundant spores of a *Botrytis* form, the question of its genetic connection with the *Sclerotinia* became a very interesting one. The specimen was carefully preserved, and the spores were obtained quite pure for a series of cultures. When sown on prune-gelatine they produced a luxuriant mycelium, whose growth was accompanied by a characteristic formation of crystals of oxalate of lime. From this mycelium were developed numerous attachment organs, like those above described, and spore threads, with spores, identical with the original *Botrytis* form. Except for its physiological similarity in the production of oxalate of lime and the structural similarity of its attachment organs, there was no ground for suspecting any connection between this form and the *Sclerotinia*. Sown on bread saturated with prune infusion, the original spores gave results precisely similar to those above described. When sown on a solid block of sterilized potato in a test tube, however, they produced not only abundant attachment organs and spore threads, but also sclerotia. Nine days after the beginning of a culture, very dense masses of mycelium were seen at the angles of the block of potato, and two days later well-formed young sclerotial masses occupied the same positions. These matured fully, and showed, in their microscopic structure and in their reaction for glycogen, complete identity with the sclerotia developed from the ascospores of the *Sclerotinia*. The sclerotial masses did not form a rind on the side next to the potato, and remained closely adhering to it; but this was probably due merely to the character of the substratum. It is of interest to note that the spores of the second generation from the original material failed to produce sclerotia on any of the substrata mentioned; but the positive evidence of a single culture is worth any number of failures. There is no possibility of the contamination of the successful cultures by ascospores, for at the time they were made not a single *Sclerotinia* cup was or ever had been in existence in the laboratory. The culture was made with a drop of distilled water containing a few spores, and showed no evidence of the presence of any other mycelium or spore form than the *Botrytis.* I have preserved the block of potato with *Botrytis* threads and sclerotia as evidence of the correctness of these statements. It is, I believe, quite within bounds to say that the results described raise a very strong presumption in favor of the view that *Sclerotinia Libertiana* possesses a conidial stage of the *Botrytis* type. This view is further strengthened by the observations to the same effect made in the study of a disease of rape by Frank,* although he identified his *Botrytis* as one which is known to be connected with another species of *Sclerotinia.*

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* Botanische Zeitung, 1886, Nos. 22-27.

As to the identity of the *Botrytis* in question, the indefiniteness of the descriptions of the various so-called species, and the undoubted multiplication of specific names beyond all reason, render it difficult to speak with certainty. But the form on the cucumber appears to me to be identical in all respects with that previously described † as the cause of the rotting of lettuce in the greenhouse, and believed to be the form known as *Botrytis vulgaris* Fries. Some points of its structure are poorly shown in fig. 13. Unfortunately, I was not able to make infection experiments when living spore material was available; but, in view of Kissling's results ‡ with a closely related *Botrytis*, it seems probable that the conditions which govern its attacks as a parasite are similar to those above described for the ascosporic form.

Consideration of the life history above sketched shows clearly that the key to the situation, so far as the control of this disease is concerned, is to be found in the destruction of the sclerotia. If plants which show the disease be promptly removed and destroyed, and the development of sclerotia be thus prevented, while careful watch is kept for any sclerotia accidentally allowed to form, one need have little fear of serious loss in future crops, even on the same soil. It is only where diseased plants are neglected, and sclerotia are allowed to develop and fall to the ground to serve as sources of infection for the next crop, that serious attacks can continue from season to season. The control of this disease does not require even the trouble of spraying, but merely the practice of what should be ruling principles in every greenhouse, *cleanliness* and *watchfulness*.

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* Die Krankheiten der Pflanzen, p. 530: 1880.

† Ninth Report Massachusetts Experiment Station, p. 219.

‡ Hedwigia, 1889, p. 227.

In conclusion, it may be of interest to review briefly the known parasitic species of *Sclerotinia*. We need notice only those which are capable of really parasitic life, and are thus truly disease-producing fungi. *Sclerotinia Libertiana* F'k'l., the above-described species, was one of the earliest studies. Our first exact knowledge of it is due to DeBary,* Brefeld † and Mattirolo,‡ who described the sclerotia and the perfect form, while later DeBary § worked out the very interesting conditions on which its parasitic life depends. He cultivated it on a great variety of plants, including the turnip, beet, carrot, radish, potato, petunia, zinnia, bean and others. Brefeld found it attacking the Jerusalem artichoke, and Frank ‖ observed a disease of rape produced by it. It is probable, too, that the disease of hemp observed by Tichomiroff¶ in Russia is due to the same species. The cucumber has been found by Smith ** to be attacked by a fungus which he identified as *Botrytis vulgaris*, but which he regarded as only a saprophyte. It was probably the conidial stage of this *Sclerotinia*, and the discovery of its perfect form on the same host is therefore very natural. Many additions to the list of its host-plants are likely to be made.

Sclerotinia Fuckeliana DeBary is one of the best known of these forms. It attacks especially the leaves and fruits of the grape vine in Europe, and is found on the herbaceous parts of various plants, chiefly in its conidial form, known as *Botrytis cinerea*. Although, as in *Scl. Libertiana*, the conidial form usually reproduces itself persistently, the sclerotia give rise under favorable conditions, when just matured, to the *Botrytis* form. When older, they produce the spore cups of the perfect form. These facts make the demonstration of the connection of the two forms much easier than in *Scl. Libertiana*. A disease of onions described by Sorauer[*] appears to be due to this species. Its conidial form has been the subject of important studies by Klein,[†] Müller-Thurgau[‡] and Kissling.[§]

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* Morphologie and Physiologie der Pilze, pp. 35, 60, 201: 1866.

† Botan. Unters. über Schimmelpilze, IV., p. 112: 1881.

‡ Nuovo Giornale Botanico Italiano, XIV., 200: 1882.

§ Botanische Zeitung, 1886, Nos. 22–27.

‖ Die Krankheiten der Pflanzen, p. 530: 1880.

¶ Bulletin Soc. Naturalistes de Moscou: 1868.

** Gardeners' Chronicle, XXV., p. 173: 1876.

Sclerotinia Trifoliorum Eriks. has been shown by Kühn,[||] Rehm[¶] and Ericksson[**] to cause a serious disease of various species of clover. No conidial form has yet been connected with it. From Wakker's[††] account it would seem that a very destructive disease of various bulbs (hyacinth, narcissus, crocus, scilla, etc.) in the great propagating fields of Holland is due to the same fungus. On either of its host-plants it penetrates and destroys the tissues rapidly, leaving finally only their shrivelled remains.

A disease of the European whortleberry was described by Schroeter[‡‡] in 1879, and by him attributed to one of these fungi, which he called *Peziza baccarum.* The subject was taken up later by Woronin, who has distinguished[§§] four closely related species that attack the fruits and leaves of European *Vaccinia.* The one which he has studied in most detail is *Sclerotinia Vaccinii* Woron. This species has a summer spore form, not of the *Botrytis* type, but very similar to our common fruit-rot fungus, *Monilia fructigena.*[||||] There is no reason why these or similar species may not be found attacking our American blueberries or cranberries, and producing the "white blueberries," so often regarded, and sometimes justly, as freaks or sports.

Finally, there may be mentioned, as of interest in this connection, the disease of garden lilies studied by Marshall Ward,[¶¶] and shown to be due to a *Botrytis* apparently distinct from those above mentioned, and very probably the conidial stage of an unidentified *Sclerotinia.*

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[*] Handbuch der Pflanzenkrankheiten, II., p. 294: 1886.

[†] Botanische Zeitung, 1885.

[‡] Landwirthschaftliche Jahrbücher, XVII., p. 83: 1888.

[§] Hedwigia, XXVIII., p. 227: 1889.

[||] Hedwigia, IX., p. 50: 1870.

[¶] Entwickelung eines Kleearten zerstör. Pilzes; Göttingen, 1872.

[**] Kgl. Landsbr. Akad. Handlingar: 1880. See Bot. Centralbl., I., 296.

[††] Allgem. Vereen. voor Bloembollencultur te Haarlem, 1883-4; and Archiv Neerlandaises, XXIII.

[‡‡] Hedwigia, XVIII., p. 177: 1879.

[§§] Mém. Acad. Sci. St. Petersburg, Sér. 7, t. XXXVI.: 1888; and Bericht. Deutschen Bot. Gesellschaft, III., p. LIX.: 1885.

[||||] Eighth Report Massachusetts Experiment Station, p. 213; and Pl. II.

[¶¶] Annals of Botany, II., p. 319: 1888.

2. THE POWDERY MILDEW. — *Erysiphe Cichoracearum* DC. (Plate III.)

In the last report of this department* an account was given of this disease, which was then described for the first time in America. No new facts concerning it have since been learned; but as drawings intended to accompany that account were unfortunately lost in the mail, new ones have been prepared for publication in the present report, and a brief recapitulation of some facts concerning it may serve to explain these figures to those who have not the previous report at hand.

Like all the powdery mildews, this plant is a surface parasite, its vegetative threads running over the exterior of the host (fig. 14). The epidermal cells of the latter are pierced at intervals by short, thick branches, sent downward from the vegetative threads, whose office is the absorption of nourishment for the fungus from the invaded host cells (fig. 14, *h*). From the vegetative threads are also produced erect spore threads (fig. 14, *sp.*), which bear the summer spores of the fungus. These are cut off in basipetal succession by cross partitions, the apical spore being thus always the oldest and falling from the chain as soon as it is fully ripe (fig. 15). These ripe summer spores (fig. 16) germinate quickly, and serve to spread the fungus rapidly. The fact was mentioned in our previous report that the spores on diseased cucumber leaves, received from Fitchburg, Mass., and from Ithaca, N. Y., respectively, did not fully correspond in size and form, and may possibly represent different species of fungi. Their differences may be seen by comparing the figures given. While all the other figures are taken from the Massachusetts form, fig. 17 represents the larger summer spores of the New York one.

Before the publication of the previous account of this fungus, only its summer spore form was known on the cucumber, and its specific identity, which depends upon the winter stage, was therefore undetermined. The appearance of the winter form in our greenhouse has made this identification possible, and has shown that the Massachusetts form, at least, is one of the most common and widely spread members of the group *Erysiphe Cichoracearum.* The winter stage consists of tiny, dark-brown, rounded capsules, consisting of a firm outer crust of compacted cells, enclosing a group of spore sacs. Within these sacs, when mature, are formed the spores. The structure of the perithecia, asci, spores and haustoria of the cucumber fungus identifies it beyond doubt as the species above named. I have not been able to duplicate the lost drawings of a perithecium, but fig. 18 shows a group of characteristic asci with spores, and fig. 19 a single ripe spore. These spores undoubtedly carry the fungus over from season to season, but nothing is yet known as to their germination and further development.

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* Ninth Report Massachusetts Experiment Station, p. 222.

3. THE DOWNY MILDEW. — *Plasmopara Cubensis* (B. & C.) Humph

In a previous report of this station* will be found an account, with figures, of this downy mildew of cucurbitaceous plants, which, though but recently recognized in this country, has come to be a serious pest. So far as I know, its occurrence on the cucumber plant in the greenhouse has not heretofore been mentioned, though it has often been observed in the open air and in the hot-bed. This fungus was received about October 1, in large quantity, on leaves of greenhouse cucumbers, from Messrs. C. H. Chase & Son of Clinton, who report that they have suffered from its attacks for two years previous to the present. On leaves attacked by this fungus, it is not commonly sufficiently abundant to be recognized by the unaided eye, as the spore threads are rather thinly scattered over the lower faces of the leaves. But on the material above mentioned the development of the fungus was very luxuriant, perhaps from the peculiarly favorable conditions afforded by the greenhouse. The lower leaf surfaces showed the distinctly purplish tint, due to the abundant development of summer spores, which characterizes the presence of various nearly related fungi on other hosts. These individuals presented no differences in structure from those developed out of doors, but the difference in luxuriance of development was very striking.

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* Eighth Report Massachusetts Experiment Station, p. 210, and Pl. II.

This parasite is very destructive under favorable conditions, but there is no reason to doubt that thorough and timely spraying will control it, at least where the host-plants are otherwise in a condition to make healthy growth.

4. Damping Off. — *Pythium DeBaryanum* Hesse.

Seeding plants of many species have long been known to be destroyed in great numbers by the affection known as "damping off." To the number of those known to be thus affected was added in a previous report* the cucumber plant, and the cause of the trouble was shown to be the same fungus to which it is commonly due in Europe. The same fungus has repeatedly been met with in the cucumber house during the past two years, and has caused much loss of time and of plants. Last fall seedlings which had started well in a bed of fresh, rich soil, just taken from a compost heap where it had lain for at least two years, were so generally attacked that nearly all were lost. The attacks were so nearly simultaneous that there can be no doubt that the fungus was generally diffused throughout the soil; and, unless it is able to propagate itself in some way of which we now know nothing, the spores from which the infection originated must have remained alive in the compost for a long time. Unfortunately, no practicable treatment can be recommended beyond the removal of affected seedlings, with the surrounding soil, as quickly as possible after they show the presence of the fungus.

5. The Leaf Blight. — *Cladosporium cucumerinum* Ell. & Arth. (Plate IV.)

Early in October we received from Messrs. C. H. Chase & Son of Clinton some cucumber plants whose stems and roots were quite healthy, while the leaves were badly wilted, and had a peculiar watery appearance. Everything indicated that here was a definite disease, as leaves on a given plant showed various stages in its progress, those in the latest stages being reduced to a mass of decaying tissue, while those in the earliest stages were just beginning to wilt and to show translucent watery spots. The senders reported the trouble as one quite new to them. They stated that it may show itself on any part of the plant and spread rapidly over the whole, so that all the leaves are practically destroyed in two or three days. In spreading from plant to plant, they observe, it seems somewhat erratic, attacking one here and another there, without order, but eventually taking all in the bench. It will be seen that this is a very serious affection where conditions favor, and one of much importance, from the extent of its ravages and the rapidity with which it does its work.

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* Eighth Report Massachusetts Experiment Station, p. 220, and Pl. II.

It was impossible to recognize the presence of any fungus with the unaided eye, and the fact of such presence was at first doubted. But microscopic examination demonstrated the presence on all diseased leaves, even in the earliest stages, of the mycelium and spore threads of a fungus of the imperfect form germs *Cladosporium*. The mycelium of the fungus (figs. 25 and 26, *m*) grows freely within the leaf tissue, and after it is well developed sends branches to the surface through the pores (*stomata*) of the lower surface of the leaf. Frequently several of these threads come to the surface through a single pore. Just at the mouth of the pore there is usually formed a closely packed mass of small cells, which originates from the threads, but whose precise development I have not followed. This may be called the *hyphal knot* (fig. 26, *a*), and is ordinarily large enough to conceal, nearly or wholly, the guard cells of the pore. From this knot arises a cluster of few or several erect spore threads (fig. 25). These threads, at first simple, may remain so indefinitely, cutting off the simple spores (fig. 25, *sp.*) from their ends; or they may branch, producing at their ends short cells with all the characteristics of spores, which may remain attached to the threads and undergo further development. This results in the most highly complicated form of the spore threads, and consists in the successive acropetal production of sprout buds from the originally terminal joints, so that there are formed chains of successively smaller and smaller cells, producing a much branched and very complex appearance (fig. 26). All the cells thus produced appear to be functional spores, and the rapid spread of the disease in the greenhouse shows how promptly they are capable of germinating and infecting fresh tissues. Unfortunately, I had no suitable plants for infection at the time the material was received; but a careful study of the various stages of the disease presented by the different leaves of a plant affords little room for doubt that this fungus form is its efficient cause.

The only mention of a disease of this host caused by a similar fungus that has come to notice is that by Arthur,* who has described the development of decayed spots on cucumber fruits, observed by him in New York and Indiana. In this case the cause of the decay, which was a source of much loss, appeared to be a *Cladosporium* form, which the writer called *Cladosporium cucumerinum* Ell. & Arth. It is impossible to say that our leaf-destroying form is the same as this which attacks the fruits, but there is no reason for assuming them to be different. On the other hand, it is by no means certain that either the leaf or the fruit form is distinct from forms previously known on other hosts. Indeed, the accumulation of evidence that the common form known as *Clad. herbarum*, until very recently regarded as only saprophytic, is capable of actively parasitic life, must weaken one's doubt that most of the related forms possess the same capacity. Our knowledge of the *Cladosporium* forms is very fragmentary, and there can be no doubt that a thorough study, based on detailed cultures of the various forms, would result in a great reduction in the number of so-called species. For the present, then, our parasite may bear the name given by Ellis and Arthur, in the sense that it is a *Cladosporium*, attacking cucumber plants, without any necessary implication as to its real distinctness from forms attacking other host-plants.

It seems altogether probable that prompt spraying as soon as this disease begins to appear will prevent its spread to healthy plants. But, in view of its rapid progress, a very little delay may be fatal.

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* Sixth Report New York Experiment Station, p. 316, 1888; and Nineteenth Bull Indiana Station, 1889.

6. THE LEAF GLAZE. — *Acremonium* sp. (Plate IV.)

Early in 1891 cucumber leaves were received from Fitchburg, Mass., whose lower surfaces showed delicate glairy films of fungus-threads, as described in our last report.* These leaves came from very badly diseased plants, which had received no benefit from the application of fungicides, although it seemed probable that the accompanying fungus bore some causal relation to the trouble. The fungus-threads on the leaves were quite sterile when received, but, when the leaf bearing them had lain two or three days in the moist chamber, produced spores abundantly. Drawings showing the structure of the fungus and the germination of its spores were made at the time and laid aside, in the hope that additional material would make possible an extension of our knowledge of the disease and of the relations of the fungus in question to it. As it has not again been met with, no further information can be given concerning it, and we can only complete the record of our meagre knowledge of the subject by publishing herewith the drawings mentioned.

The film on the leaves consists of numerous delicate, colorless and closely interwoven threads. These give rise in the moist chamber, and probably sooner or later under natural conditions, to short simple threads at right angles (fig. 27), at the slightly knobbed apex of each of which is produced a single somewhat kidney-shaped spore (fig. 28). In water these spores swell up and produce stout germ tubes of considerable length, similar to the original threads of the film (fig. 29). This is all we know of the fungus. It is to be hoped that some investigator may be able to study it in detail, with the disease it accompanies, and to answer the many interesting questions concerning it which still await an answer.

7. OTHER DISEASES.

Two other diseases of some importance, which have not yet been observed in Massachusetts, but may at any time be met with, may be briefly mentioned in conclusion.

Halsted has described † a serious rotting of cucumbers and other cucurbitaceous fruits, which is accompanied by and seems to be due to a form of *Bacterium*. It appears to be readily communicated by inoculation, and sometimes causes very serious and rapid loss.

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* Ninth Report Massachusetts Experiment Station, p. 227.

† Botanical Gazette, 1891, p. 303; and Twelfth Report New Jersey Station, p. 273.

At various times and in various places the fruits, and sometimes stems and leaves, of the cucumber have been observed* to be attacked by a disease of the type now generally termed anthracnose, produced by some of the fungus forms included under the name *Glœosporium*. The forms have been called by different names by different writers, and it may be doubted whether they are all identical. Some of them appear capable, under some conditions, of great destructiveness. Nothing is known as to the perfect forms of the fungi in whose life cycles they constitute stages.

II. A VIOLET DISEASE. — *Phyllosticta Violæ* Desm.

In the summer of 1891 my attention was called by W. D. Philbrick, Esq., of Newton Centre, to a disease of cultivated violets (*Viola odorata*), from which he and other growers had suffered severely for several years. A visit to his and neighboring grounds showed the plants, at that time growing in the field, to be badly attacked. The leaves showed very numerous circular whitish spots, averaging about an eighth of an inch in diameter. In many instances these spots had run together, and in the worst cases whole leaves were covered by the spots and involved in a general decay. From the parts of the field where the trouble was most serious there arose an almost sickening odor of decay, and here nearly every plant was badly affected. It was very noticeable that the most commonly grown variety, the Marie Louise, was the greatest sufferer, while the double Russian, with its stockier foliage, was far less attacked, and the single Russian least of all. Another striking fact, and one which one would hardly expect to be a fact concerning a fungous disease, is that plants growing in the shade of a tree and so protected by it as to be still wet with dew in the afternoon were the healthiest in the field, and showed hardly a trace of disease. The impression made by an inspection of the fields was very decidedly in favor of the supposition that the trouble in question was a disease of the leaves, due to the organism causing the spots.

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* Gardeners' Chronicle, 1876: V., pp. 438 and 505; VI., pp. 175, 269, 303, 336, 370, 400, 495. First Report Insect and Fungous Pests of Queensland, p. 175: 1889.

Close inspection of the spots showed tiny black pustules on each; and these proved to be the conceptacles or spore fruits of the fungus, whose development in the leaves causes the death of their tissue in certain regions, and thus produces the spots. The conceptacles appear to belong to that fungus form known as *Phyllosticta Violæ* Desm. It is one of the so-called "imperfect fungi," whose perfect or winter-spore form and other summer-spore forms have not yet been determined.

In the fall of 1891 both healthy and diseased plants were received from Mr. Philbrick, and were set in a bench and in a box in the greenhouse. Those which were diseased when sent did not become established so readily as the others, and, although they lived for a time, they eventually succumbed and other diseased plants were set in their places. These met the same fate. Plants with dead or dying foliage were several times removed and carefully examined throughout. In some cases the roots appeared perfectly healthy, but in others there were plainly found the characteristic root galls produced on many plants by a *Nematode* worm. These were, however, abundant in no instance, and the roots were never sufficiently involved to account for the death of the plant.

With a thought of the possibility of a complication of the fungous trouble by some other affection, Mr. Philbrick had been asked to watch carefully for any abnormal appearance of the roots, and especially for any root galls, when transplanting his violets from the field to the greenhouse. He reported that, among three thousand plants, the roots of all but six seemed quite healthy. These six plants were sent to the station, and were found to bear the familiar *Nematode* galls in small numbers. Four of the affected plants were set in a box and submitted for a month to precisely the same treatment. After they had become well established, they were separated into two lots of two each by a heavy tin plate of the full size of the box. The plants of one lot were now watered every few days with about half a pint each of a solution of one part of permanganate of potash in two thousand parts of water. Those of the other lot received none of the permanganate, but an equal quantity of water, and were, in other respects, under identical conditions. In three weeks a difference between the two lots was evident, and in a month it had become very conspicuous. The foliage of the treated plants was deeper green and much more abundant than that of the others. Ultimately the plants which received no permanganate died completely, their leaves turning brown over their entire surfaces, but showing no trace of the spot fungus. The plants which received the permanganate remained vigorous and healthy until taken out in the spring.

In view of this experience, Mr. Philbrick was advised to try the same treatment on a larger scale. This he did, and reported, after an experiment extending through a large part of February and March, 1892, that he could see absolutely no difference between treated and untreated plants. There is no reason for doubting and every reason for believing that this experiment was properly carried out, but its results are puzzling, in view of our experience with a few plants at Amherst. In the latter case the plants were in excellent soil, and the result cannot be attributed wholly to any possible fertilizing effect of the potash salt. It should be said, too, that the plants which died had still an apparent abundance of healthy roots, and their death did not appear to be due to the few Nematodes which were present. This view is sustained by the fact that plants died with the same symptoms in the bench, which showed no trace of Nematodes or of any disease of the roots. It is, however, true that the Nematodes in the roots of the treated plants disappeared, presumably as a result of the treatment, which has been used with success against root-attacking Nematodes.

In view of all the above facts, it seems most logical to conclude that, in the case of Mr. Philbrick's violets and in the death of plants at Amherst, root Nematodes have little or no share. We are left, then, to consider the only other foreign organism observed in connection with the trouble, the leaf-spot fungus. This, it may be said, has been believed by Mr. Philbrick from the first to be the efficient cause of the disease. In April, 1892, a lot of plants, both healthy and badly attacked by the leaf-fungus, both those which had and those which had not been treated with permangate, were received from Mr. Philbrick. These were divided, as is the custom with violet growers, so as to leave a good portion of root to each, and set in good soil on one of the station plats. As they made new leaves no signs of the fungus were seen, and it was determined not to spray them at all unless the appearance of the fungus should demand it. Unfortunately for our study of the disease, the fungus did not appear during the summer, except on a very few leaves, and no test of the efficacy of spraying as a preventive of its spread was possible. Mr. Philbrick's experience was different. He sprayed a part of his plants with the ammoniacal carbonate of copper until about the middle of August, when a few days of warm, damp weather occurred, and the disease spread rapidly and fatally. As he could see no difference in the degree to which sprayed and unsprayed plants suffered, he gave up the treatment in disgust, and lost nearly all his plants. If it be true that the leaf-spot fungus is the cause of this very destructive disease, from which many violet growers near Boston suffer, — and all the facts now at hand point to this as the correct conclusion, — there is no apparent reason why thorough and persistent spraying with one of the copper preparations should not prove very efficient in holding it in check. And Mr. E. O. Orpet of South Lancaster informs me that he has had excellent success with this treatment. The failure above quoted was probably due to some error in carrying out the treatment. So far as I have been able to learn the details, the intervals between the applications were apparently so long as to leave the plants unprotected for a time in each interval. One of these periods of exposure coming in weather favorable to the spread of the fungus would be quite sufficient to account for the result; for, as has been so often said, a plant once infected is lost. The secret of immunity lies in complete protection of the plants against infection. A word more may not be out of place here. It is a common practice of growers of violets to keep them in activity during the entire year, forcing the vegetative growth during the summer and fall, and forcing the blossoms during winter and spring. That this practice is exceedingly weakening to the plants, and renders them more susceptible to the attacks of disease-producing organisms, cannot be doubted. The more rational practice of some growers, of giving the plants a rest in the cold frame during a part of the year, cannot fail to produce more sturdy plants; and it may be doubted if it is not in the long run more profitable, when all factors are taken into account.

III. THE BLACK KNOT OF THE PLUM. — *Plowrightia morbosa* (Sz.) Sacc. (Plate V.)

Work on other diseases has crowded out much which has been planned in continuation of that already reported * on this important trouble, but a few words may be added, especially in regard to the practical treatment of the disease. During the past year cultures with the ascospores and pycnospores of the fungus have been carefully repeated, with results in every case identical with those reported in our previous account. On bread saturated with an infusion of prunes, pycnospores, taken from pycnidia developed from ascospores on prune gelatine, produce a very luxuriant mycelium. This mycelium, at first white, soon assumes a salmon-red tint, and later becomes black. The first pycnidia on such a culture were ripe in five days from the sowing of the spores; but others continued to form until the entire surface of the substratum was covered by a compact pycnidial crust. This pycnidial form seems to be very rarely developed under natural conditions, but there can be no doubt that it belongs to the life cycle of the "black-knot" fungus. It seems very probable that some relation exists between its suppression and the facts next to be detailed, but this is not the place for the discussion of such probabilities. Careful experiments have been made as to the power of the pycnospores to infect the living tissues of the host-plant. It is clear that one or more of the spore forms of the fungus must possess such power, and it was hoped that experiments with each of the known forms might before now have been made. But this has not been possible. In case of the pycnospores it has been found that they are quite incapable of attacking any of the living tissues of the host. They have been sown on sound and on injured leaves, and on stems of various ages, on those of the season and those of one, two and more years old. Whether sown on the intact surface of the stem, or allowed free access to the freshly exposed living tissues of the inner bark (Phloëm), the results have been the same. No development of knots has followed any of the sowings, nor has any trace of mycelial threads been found in the tissues exposed to them. It seems pretty certain, then, that they play no important part in the spread of the fungus.

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* Eighth Report Massachusetts Experiment Station, pp. 200–210, and Pl. I.

Prevention. — Since we do not yet know the details of the infection of the host-plant by this fungus, we are not in a position to use fungicides intelligently. It is doubtless true that spraying at intervals during the whole period of the ripening and escape of both winter and summer spores, namely, from January to June, will largely prevent the attacks of this disease. But it is hardly less to be doubted that a complete filling of this important blank in the life history of the fungus will enable us to reduce the period of spraying to a relatively short one. On the other hand, I am convinced that the disease can be largely controlled without spraying, if fruit growers will learn to recognize its earliest appearance. The great difficulty at present lies in the fact that a few small knots, even when fully grown, often escape notice, and so serve as sources of infection; and indeed, the average man does not realize that his trees need attention and that the fungus is getting the better of them until they are so covered with knots as to be practically worthless. While, as for the early stages of the knot, before either of the spore forms have developed, no one thinks of looking for them and removing them when removal is of some avail. It is very rarely that a tree is badly attacked the first season. Commonly the beginning is the appearance of one or two small knots, of very little consequence alone, but sufficient to infect the whole tree in two or three years, if left. After a very little experience any one can recognize the forming knot even before it bursts the bark, and before it has done serious mischief. No one would mistake the large knot on the middle branch in Pl. V.; but it has matured two crops of spores and done its work, and to remove it is a waste of time and labor. But just beneath it on the branch, and on each of the side branches, is a smaller and less conspicuous swelling, whose bark is just bursting. These swellings are knots a year younger than the large one, and have ripened no spores. The thorough removal of these is preventive work of the best kind. I firmly believe that a man who will start with healthy trees and will carefully examine them for these young knots about the last of April in every year (for the climate of Massachusetts), thoroughly removing and burning all that are found, need have very little fear of black knot. Where a small branch is attacked, one need only cut it off some distance below the knot. Where, as will rarely happen if trees are carefully looked after annually, a large branch whose removal would seriously injure the tree is involved, the knot may be carefully dug out until healthy bark is reached in all directions. The exposed tissues may then be painted over with a heavy coat of red oxide of iron in linseed oil. This coating will serve as a protection, and will also, by its color, enable one to readily find the treated spots and to watch them for any further development of the fungus. The application of kerosene to the knots, while doubtless fatal to the fungus, is likely to be equally so to the tissues of the tree, and is not to be recommended as a general practice.

For the greatest success in dealing with the black knot, it is, of course, a prime necessity that sources of infection shall be reduced to a minimum. Neighboring plum or cherry trees or wild plants of the various native species of plums and cherries may serve as propagators of the fungus, and make one's labors much greater and his chances of success much smaller. The great desideratum in this regard is an intelligent and active public sentiment, which shall compel the destruction of all such plague-breeders. A few of our States have accepted the suggestion that the matter be made the subject of legislation, and have enacted laws to compel the destruction of trees infected by the black knot. One may, however, well doubt the utility of such legislation. It is interesting, as showing the beginning of toleration for subjects which, not long ago, would have been thought unworthy of serious attention. But the enforcement of thorough-going legislation is not possible without the active support of public sentiment; and a public sentiment sufficiently aroused to execute the law would accomplish the desired result without legislation.

IV. Grain Rusts (*Puccinia* sp.).

Last spring an attempt was made by this department to enlist the practical farmers and gardeners of the State in aid of a plan for the organization of a system for the report of the prevalence of plant diseases in any locality. It has been manifestly impossible for the writer to travel about the State, and, at the same time, to carry on studies in Amherst, and the value of organized co-operation has been long realized. Therefore a special circular to those concerned was widely distributed, and it was hoped, in view of the interest in the work of the department which had been shown in some quarters, the response might be encouraging. It proved, however, disappointing in a marked degree. While five or six of the most intelligent cultivators in the State responded promptly, they remained the only persons who did so. This test must prove interesting to pathologists at least, as showing what support they may expect at present from people reputed to possess a high average degree of intelligence. It is clear that agriculturists and horticulturists in general are not yet willing to go out of their way even to aid work carried on in their interest and for their benefit. And it is the experience of the writer that only the most wide-awake of them are willing to avail themselves of the results of such work, if it involves the least deviation from the old ruts. But it is noticeable that those who are alive to the results of modern investigations are not those who complain that "farming doesn't pay."

It had been hoped to obtain from correspondents pretty full information concerning the rusting of grains during the season, as this constituted the special subject of inquiry for the year of the International Phytopathological Commission. In the absence of information from these sources, the writer has been compelled to rely upon others, especially the various official crop reports. It seems that, so far as New

England is concerned, the season has been far less favorable to the development of the rust fungi than in previous years. The losses appear to have been very light from this cause, and it has not been possible to obtain data of value concerning them. The only crop distinctly mentioned as suffering at all has been oats, and it is by no means certain that the cause of its affection was one of the species of *Puccinia* to which the true rusting of grain is due. The season of 1892 must, therefore, be set down as one of unfavorable conditions and negative results in New England.

V. NOTES ON VARIOUS DISEASES.

1. THE POWDERY MILDEW OF THE STRAWBERRY (*Sphærotheca Castagnei* Lév. ?) (Pl. III.) was brought to my attention on the experimental plats of the Agricultural College, early last summer. The affection shows itself in a peculiar curling or inrolling of the leaves, which causes them to take a somewhat cup-like form. If the lower surfaces of the curled leaves be carefully examined, they will be seen to be frosted by minute white threads scattered rather sparingly over them. They are not grouped in more or less circumscribed spots, like those of the similar mildew of the cucumber, previously described. But microscopic examination shows that their structure is essentially like those of the "*Oidium*" form of the latter. Erect threads arising from the mycelium (fig. 20) cut off the summer spores from their ends in basipetal succession, and these fall off as they mature (fig. 21). The form and size of these spores (fig. 22) confirm the impression produced by the habit of growth that we have here to do with a species quite distinct from that which attacks the cucumber. Although I have not observed the perfect spore form, it is probable that the fungus with which we have here to do is *Sphærotheca Castagnei*.

This fungus does not appear to be very destructive to the strawberry, or to have attracted much attention. It has been briefly described by Arthur,* who observed it in New York. He found it attacking the fruit as well as the foliage, and indeed doing its chief harm in rendering the former insipid and worthless. I have not seen it on the fruits, but it may be likely to be found upon them, and in this aspect the fungus may assume, under favoring conditions, considerable economic importance. Suggestions as to treatment may be found on subsequent pages.

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* Fifth Report New York Experiment Station, p. 291, 1887.

2. THE POWDERY MILDEW OF THE GOOSEBERRY (*Sphærotheca mors-uvæ* (Sz.) B. & C.) (Pl. III.) was received, last summer, from W. C. Strong, Esq., of Waban, on the leaves, twigs and berries of the "Triomphe" gooseberry, a variety which has been claimed to be mildew-proof. In the present case the utter groundlessness of such a claim was strikingly shown, and afforded further evidence that we are safe only in speaking of varieties as more or less liable to the attacks of fungous diseases. It is not probable that any of our horticultural varieties are in any absolute sense disease-proof, and it may fairly be doubted if we shall ever originate such, without sacrifice of more essential features, even with constantly increasing understanding of the requisite qualities.

This fungus is very closely related to that last described, and differs from it only in very unimportant particulars. The mycelium forms a dense felt over the infected parts of the host-plant, and in the early part of the season is nearly colorless, and produces the "*Oidium*" form in abundance. Later, the mycelium becomes quite dark-colored, and gives rise to the perfect spore form (figs. 23, 24). As above indicated, all the younger, succulent parts of the plant may be involved, and thus not only is the season's fruit destroyed, but the normal production of new wood and preparation for another season is prevented. This gives to the fungus great economic importance, especially since it is widely distributed. It has been frequently mentioned by writers on plant diseases, and the accounts by Arthur * and Halsted † may be consulted for further information. Notes on the treatment of this class of diseases are given later.

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* Sixth Report New York Experiment Station, p. 349, 1888.

† Mycological Report, United States Department Agriculture, 1887, p. 373, with plate.

3. THE CLUSTER CUP OF THE GOOSEBERRY (*Æcidium Grossulariæ* Schum.) occurred also on some of the leaves sent by W. C. Strong, Esq., as mentioned in the previous note. Gooseberry leaves and berries very badly attacked were also received, about the same time, through the "New England Homestead," from Mr. C. C. Stickney of Ballardvale. From the facts which came to my notice during the season, it would appear that this fungus has been more than usually abundant this year. It may commonly be found in early summer on gooseberry bushes, and occurs also on some of our wild and cultivated species of currants (*Ribes*); but it is rarely very destructive. It may, however, as was seen this year, assume serious proportions, practically destroying a large part of foliage and fruit. It seems not to have attracted much attention as a cause of loss, but has lately been said by Pammel* to be quite destructive in Iowa. The form we are considering is the "cluster-cup" stage of one of the *rust* fungi. The bright yellow cups occur in groups on somewhat swollen and discolored portions of the leaves or berries, and contain the chains of spores by which the further development of the species is accomplished. It is probable that, as in other rusts, this "cluster cup" is followed by *red-rust* and *black-rust* forms. But, as these are not known to be developed on the same host-plant, they are probably produced on a second one. This would place the present fungus among the *heterœcious* rusts. So long, however, as we do not know its life history, we cannot avail ourselves of all the means of combating it.

When the cluster cup begins to appear, in spring or early summer, the harm for that season is done, and cannot be avoided. Yet, if the discolored spots be watched for and the affected parts picked and burned before the cups have burst open and discharged their spore, one may hope to escape attack in a considerable measure the following year; and the annual repetition of this practice should result in comparative immunity from the fungus. This recommendation is based on the justifiable assumption that the cluster-cup form requires for its reappearance the development of the other spore forms of the fungus, and that this last development cannot occur if the dissemination of cluster-cup spores be prevented. That this is true has not yet been proven, but, in the light of what we know of other rust fungi, it may fairly be assumed until more positive information is available.

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* Journal of Mycology, VII., p. 101, 1892.

4. A Hazel Fungus (*Cryptosporella anomala* (Pk.) Sacc.) (Pl. IV.) was left at the station in April by Mr. Henry Graves of Palmer. He reported it as killing the canes of the European hazel (*Corylus avellana*) in a plantation owned by him, and as attacking an annually increasing portion of the plantation. The fungus proved to be that known by the above name, which was first described by Peck,* who observed it on the same host at Albany, N. Y., as *Diatrype anomala*. It appears in the form of protuberances with elliptical bases (fig. 30) that burst the bark and arise rather thickly from the affected portion of the branch (*a*, fig. 30), which is sunk below the surface of the healthy part. A transverse section of the branch passing through one of these protuberances shows well the structure of the fungus and its relation to the host-plant. The interior of the protuberance, which is the fructificative part of the fungus, is seen to contain numerous black, flask-like structures, whose tips reach the surface of the protuberance (fig. 31). Within the cavities of these flasks are formed the very numerous spindle-shaped spore sacs (fig. 32), each containing, when ripe, eight colorless, elliptical spores. It is very noticeable that, in the part of the branch occupied by the fungus, the inner bark, elsewhere a distinct band of tissue, is shrunken to a narrow black line between the wood and outer bark (*a*, fig. 31). This reduction in the thickness of the inner bark explains at once why the surface of the affected parts is sunken below the rest of the surface, and shows that the chief seat of the vegetative activity of the fungus is in the rich growing and conducting tissues of this part of the branch. The destruction of these tissues must, in any event, have serious consequences for the plant; and, if the entire circumference of a cane becomes involved,

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* Twenty-eighth Report New York State Museum, p. 72, 1879.

the result is that it is girdled, and the whole of it beyond the point of girdling dies. The attacks of this fungus on its host-plant are essentially similar in their results to those of the black knot on the plum, though the immediate effect on the inner bark is here one of atrophy, while in the latter case it is one of hypertrophy. The present fungus is also nearly related to the black-knot fungus, but its life history is not yet at all known. What other spore forms constitute stages in its life cycle we have yet to learn. Therefore, it is impossible to give any more definite suggestions for avoiding it than to recommend that infected branches be cut away well below the point of infection and burned as soon as they are seen to be infected. This precaution, if taken in season, will prevent the dissemination of the spores described above, and should thus prevent the development of other spore forms dependent on them, and the infection of new branches.

VII. Treatment for Powdery Mildews.

In pursuance of the plan indicated in our last report,* we conclude the present one with recommendations for the avoidance of loss from the attacks of some chosen groups of fungi. The group selected in the present case is that embracing those fungi which are known as the powdery mildews. These parasites attack a considerable number of cultivated plants, and, as has been seen, sometimes cause extensive losses. They are among the commonest fungi of the greenhouse, but are equally common in summer, in the open air. Among the plants most often attacked by some one of the powdery mildews in the greenhouse are the cucumber, grape, rose, verbena and other florist's plants. Out of doors, the pea, gooseberry, strawberry, and young plants of the apple and cherry often suffer from them

The appearances produced on their host-plants by three species of powdery mildews have already been described in this report. In general, it may be said that it is in the summer spore stage that these fungi are most harmful as disease producers. In this stage they may form dense white "floury" patches on the host, usually on its leaves, or the spore threads may be quite sparingly developed, so that only a faint frosting is to be seen. In attacks of much severity there is commonly a discoloration, followed finally by the drying up of the tissues affected. As has been seen above in our discussion of some diseases due to these fungi, they are surface parasites. The whole fungus grows on the exterior of its host, except the small absorbing organs, which penetrate only the superficial cells. And this fact makes it much easier to deal with these fungi than with those which are truly internal parasites, since practically the whole of the fungus is exposed to the contact and action of any fungicides applied to the surface of the host-plant.

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* Ninth Report Massachusetts Experiment Station, pp. 243, 244.

It should not be necessary to insist upon the prime importance of healthy conditions, so repeatedly emphasized in these reports, and it may be assumed that it is not necessary. Supposing, then, that reasonable precautions against the appearance of fungous disease have been taken, and that one of the powdery mildews appears, what can be done? The question may be discussed under two heads, namely, What can be done for plants in the greenhouse? And for those in the open air? If the disease appears in a greenhouse, either of the applications to be recommended for out-of-door plants may be used with equal success. But, if the house can be tightly closed, we have at hand a simpler, and, from the testimony of practical men, an even more satisfactory, means of treatment. This consists in filling the air of the tightly closed house with the vapor of sulphur, which is fatal to these surface parasites, without injuring their host-plants, if the exposure be not continued much beyond half an hour at a time. After this treatment ventilators should be opened, and the house given a thorough airing. The treatment may be repeated whenever the reappearance of the fungus shows it to be necessary. The sulphur vapor is easily produced by heating the flowers of sulphur to a temperature somewhat above its melting point, and keeping it at that point as long as desired. A porcelain-lined iron vessel for the sulphur and a small oil stove for heating constitute the entire outfit needed for a small house. For a large one as many such outfits may be used as are required to yield vapor enough to saturate the atmosphere of the room. Great care must be taken that the sulphur does not become so hot as to take fire, as a brief exposure to the fumes of burning sulphur will kill cultivated plants, as well as fungi. But a little experience will soon enable one to set the flame of the oil stoves at such a height that it can be safely left to do its work.

If the plants to be protected are out of doors, it is evident that we cannot use sulphur vapor. Here we must rely on a direct application to their surfaces. Dry flowers of sulphur scattered upon the plants or blown upon them with a bellows is often of considerable service. But a solution sprayed upon the plants, by means of some of the spraying machines recommended in previous publications of this department,* is much more efficient. Formulæ for several solutions may be found in the publications just referred to,* but that most generally applicable and most satisfactory in its application and in its results is the ammoniacal carbonate of copper. The formula for this fungicide may be, for convenience, repeated here: mix one ounce carbonate of copper with five ounces carbonate of ammonia, and dissolve in one quart hot water. When dissolved, add sixteen gallons water. This may be used to thoroughly spray the plants as often as the presence of the fungus in harmful quantities shows it to be necessary. For spraying a few plants only, such as a few rose or gooseberry bushes, hand sprayers may be purchased at a price much below that of the cheapest knapsack sprayer. But care should be taken that the apparatus used throws a very fine, mist-like spray. Full directions and suggestions as to spraying in general may be found in the previous publications of this department on the subject.

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* See Bulletin No. 39, Massachusetts Experiment Station, and Ninth Report Massachusetts Experiment Station, pp. 239, 240.

EXPLANATION OF PLATES.

[*All figures are magnified 540 diameters, except where otherwise specified.*]

PLATE I.

Sclerotium Disease of Cucumber (*Sclerotinia Libertiana* F'k'l.).

Stems and young fruit attacked by the disease, showing mycelium of the fungus, chiefly at the nodes of the stems, and some external sclerotia. *a*, an early stage, the stem still green; *b*, later, the internode shrinking, and a sclerotium near the upper node; c, a late stage, the parenchyma largely destroyed, and the stem yellow; *d* and *e*, at about the same stage as *b*; *fr*, young fruit, showing mycelium and sclerotia. Natural size. From a photograph of fresh specimens.

PLATE II.

Sclerotium Disease of Cucumber (*Sclerotinia Libertiana* F'k'l.).

Fig. 1. An elongated sclerotium from the interior of a stem. Natural size.

Fig. 2. An irregular sclerotium from the exterior of the host-plant. Natural size.

Fig. 3. A sclerotium somewhat advanced in "germination," with two stalks. Natural size.

Fig. 4. Two views (*a* and *b*) of the same sclerotium, with fruit stalks, *b* four days older than *a*. Natural size.

Fig. 5. Two views of another "germinating" sclerotium, taken four days apart. Natural size.

Fig. 6. A section from the interior of a mature sclerotium. × 350.

Fig. 7. One of the fruit stalks shown in fig. 3, in vertical section. × 19.

Fig. 8. Three asci and two paraphyses from a well-developed cup. One ascus with forming spores, one with fully formed spores, and one after the escape of its spores, *sp*.

Fig. 9. Three ascospores germinated in water, after one day.

Fig. 10. Three ascospores after one day in prune infusion.

Fig. 11. A well-developed young attachment organ. × 350.

Fig. 12. A part of an old attachment organ. × 350.

Fig. 13. Spore threads and conidia (*sp.*) of *Botrytis* form, showing, *y*, young threads before the formation of spores, and, *o*, old threads after the falling away of the spores. × 200. *a*, conidia more magnified. × 540.

PLATE III.

Powdery Mildews.

Figs. 14-19. Of cucumber (*Erysiphe Cichoracearum* D. C.).

Fig. 14. Epidermis of upper surface of leaf, with mycelium, *m*, of fungus giving rise to haustoria, *h*, and spore threads, *sp*.

Fig. 15. Three spore threads, with spores in various stages of development.

Fig. 16. Two ripe summer spores not yet fallen apart.

Fig. 17. Two ripe summer spores of a similar fungus from Ithaca, N. Y.

Fig. 18. A group of six spore sacs (*asci*), with spores, from the same perithecium.

Fig. 19. A ripe ascospore.

Figs. 20-22. Of strawberry (*Sphærotheca Castagnei* Lév. ?).

Fig. 20. A bit of mycelium, with a spore thread. × 200.

Fig. 21. The upper part of a spore thread, with developing spores.

Fig. 22. Two ripe summer spores.

Figs. 23-24. Of gooseberry (*Sphærotheca Mors-uvæ* (Sz.) B. & C.).

Fig. 23. The single spore sac produced in a perithecium, with spores.

Fig. 24. Four ripe ascospores.

PLATE IV.

CUCUMBER DISEASES.—*Hazel Fungus.*

Figs. 25-26. Leaf blight (*Cladosporium cucumerinum* Ell. & Arth.).

Fig. 25. Epidermis of lower surface of leaf, with stomata, *st.*, showing mycelium, *m*, and hyphal knots, giving rise to spore threads. *sp.*, detached spores of the fungus.

Fig. 26. Mycelium, *m*, and hyphal knot, *a*, giving rise to spore threads, the latter with highly developed spore chains.

Figs. 27-29. Leaf glaze (*Acremonium* sp.).

Fig. 27. Mycelium giving rise to numerous spore threads.

Fig. 28. Ripe spores, fallen from the threads.

Fig. 29. Spores germinating in water.

Figs. 30-33. Hazel fungus (*Cryptosporella anomala* (Pt.) Sacc.).

Fig. 30. A piece of a branch of hazel, showing the depressed region occupied by the fungus, *a*, and fourteen of its compound spore fruits. Natural size.

Fig. 31. A vertical section, showing five spore cavities, through a spore fruit lying at the margin of the infested area, showing the wood of the branch, *w*, the inner bark, *a*, in normal condition at the right and destroyed by the fungus at the left, and the outer bark, *o*. × 3.

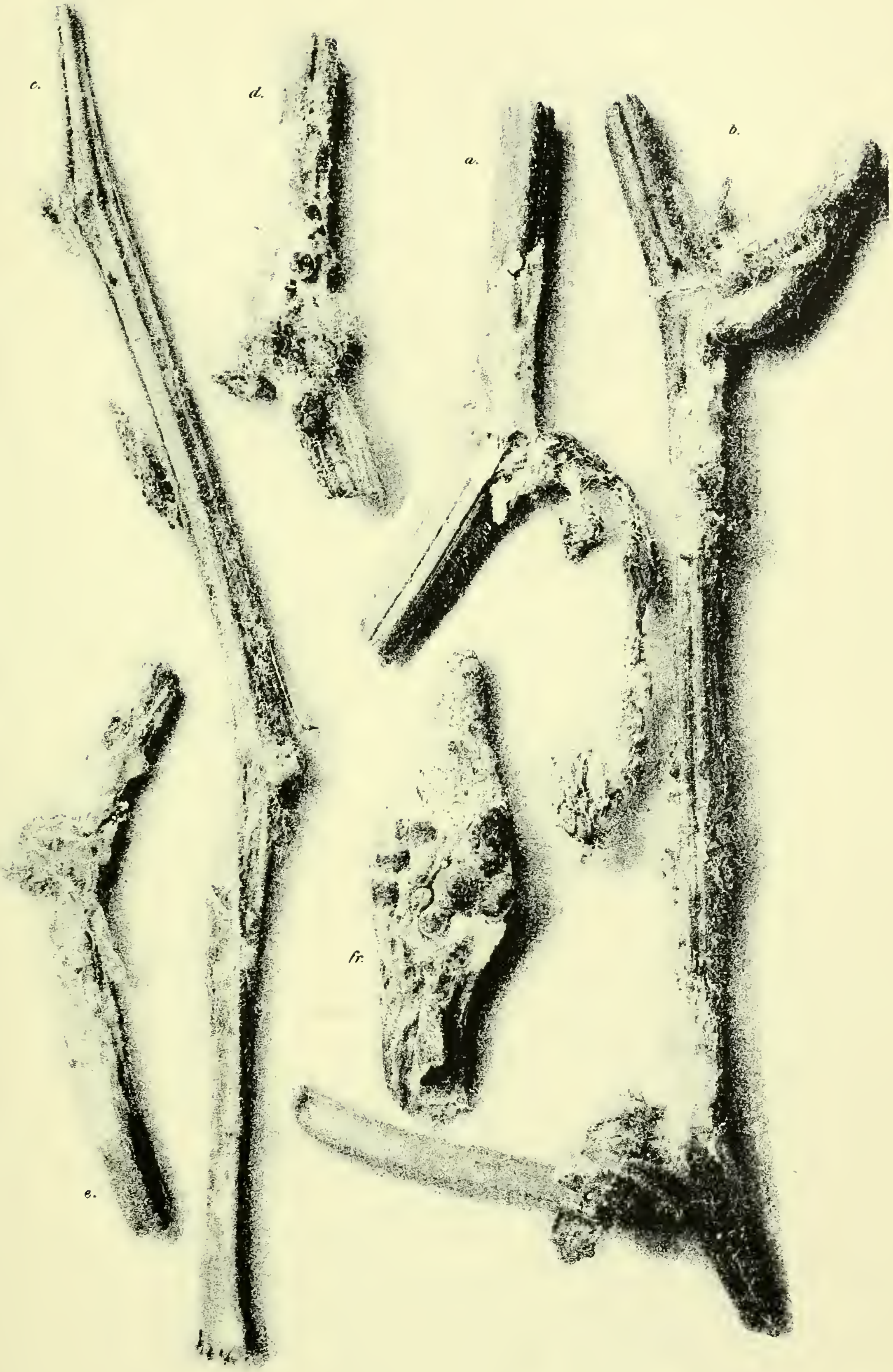
Fig. 32. An ascus with its eight spores. × 940.

Fig. 33. Three ripe spores. × 940.

PLATE V.

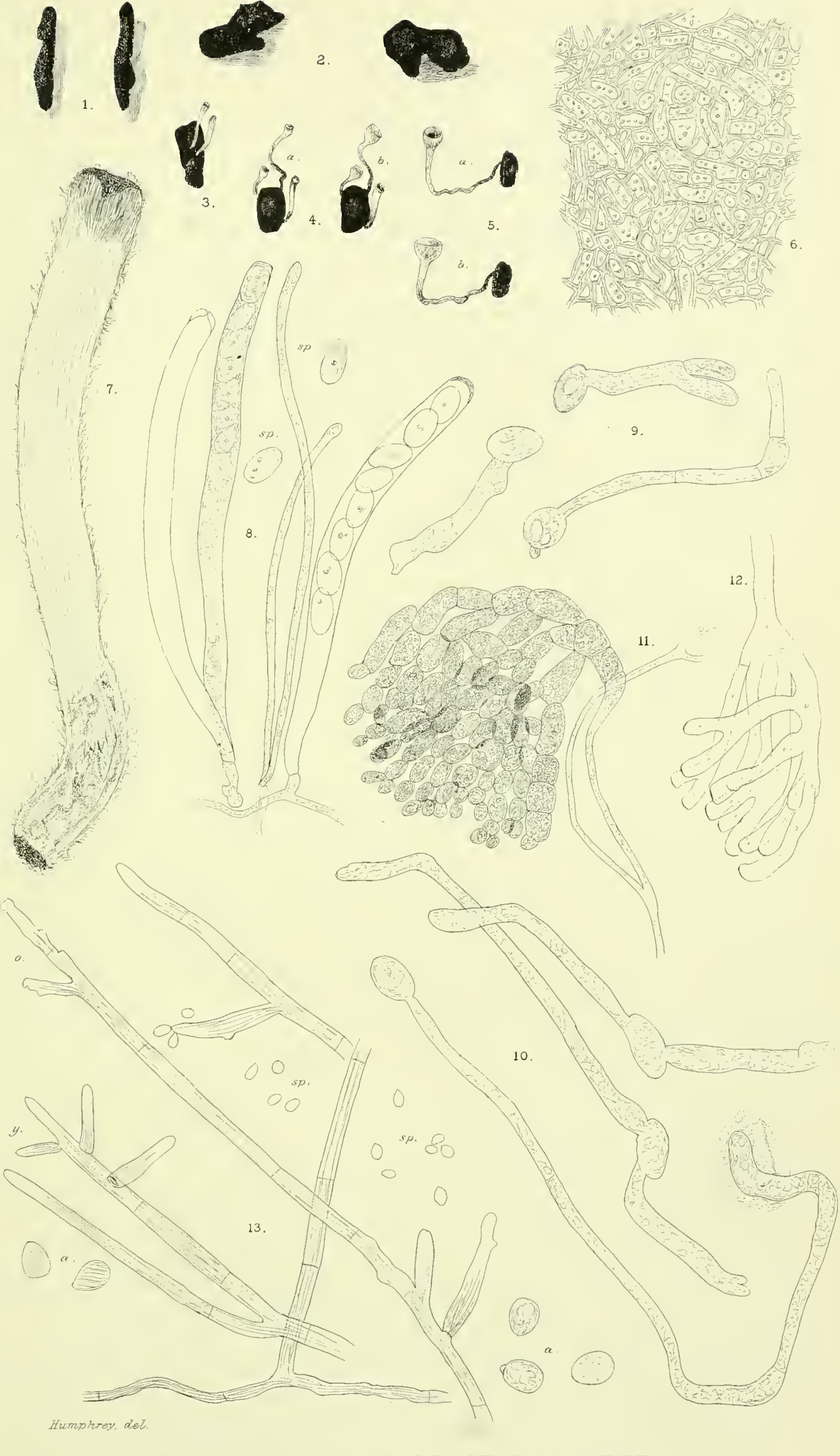
THE BLACK KNOT OF PLUM AND CHERRY (*Plowrightia morbosa* (Sz.) Sacc.).

Three young branches from the wild black cherry (*Prunus serotina*), taken about May 1, showing two stages of the knot. In the large knot, *o*, the development and escape of the winter spores has just been completed, and its activity is past. The three small knots, *a*, just bursting the bark, are a year younger than the large one, and are about to begin the production of their summer spores. Natural size. From a photograph.



SCLEROTIUM DISEASE OF CUCUMBER.

PLATE II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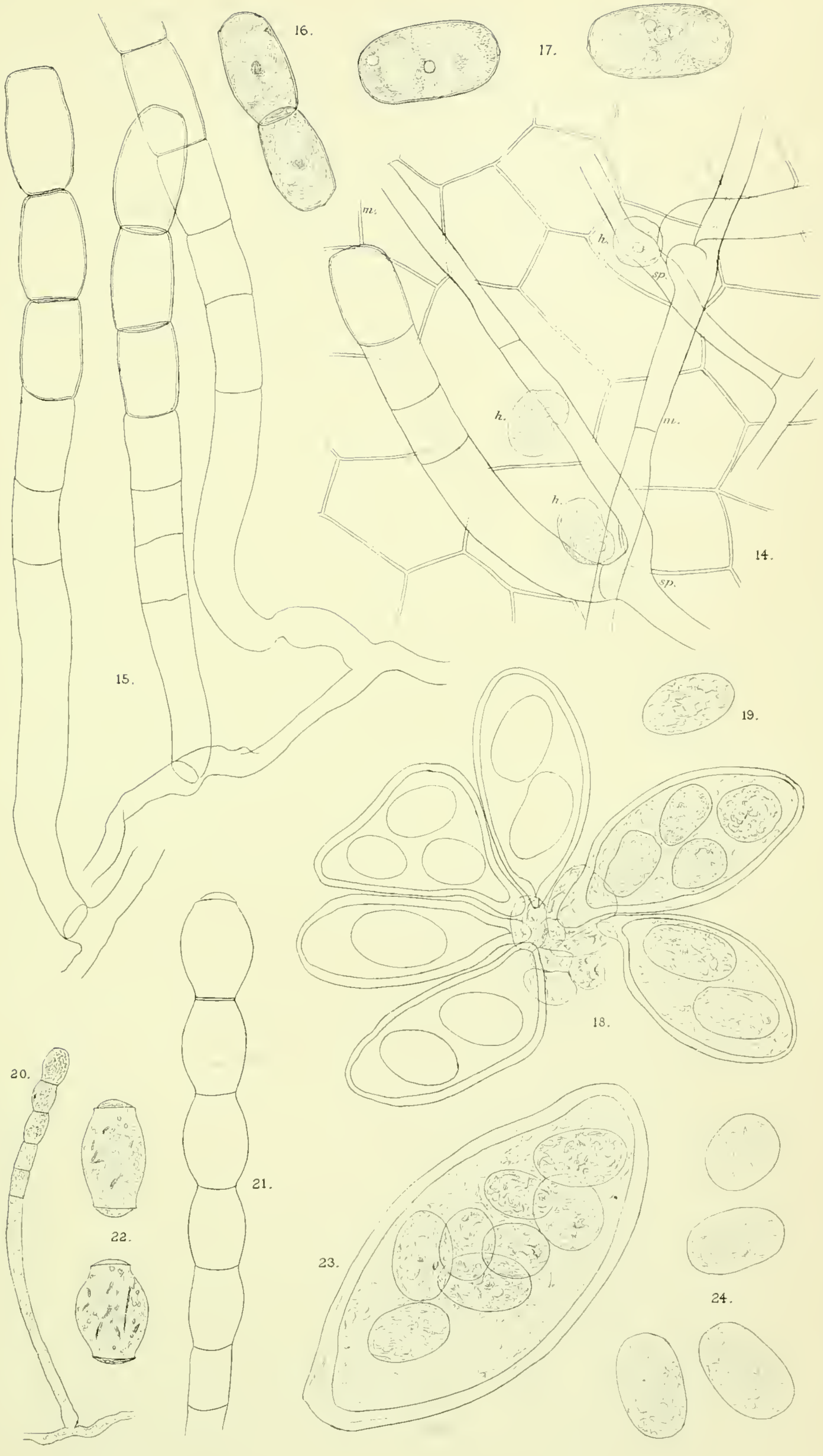
SCLEROTIUM DISEASE OF CUCUMBER.

PLATE III.



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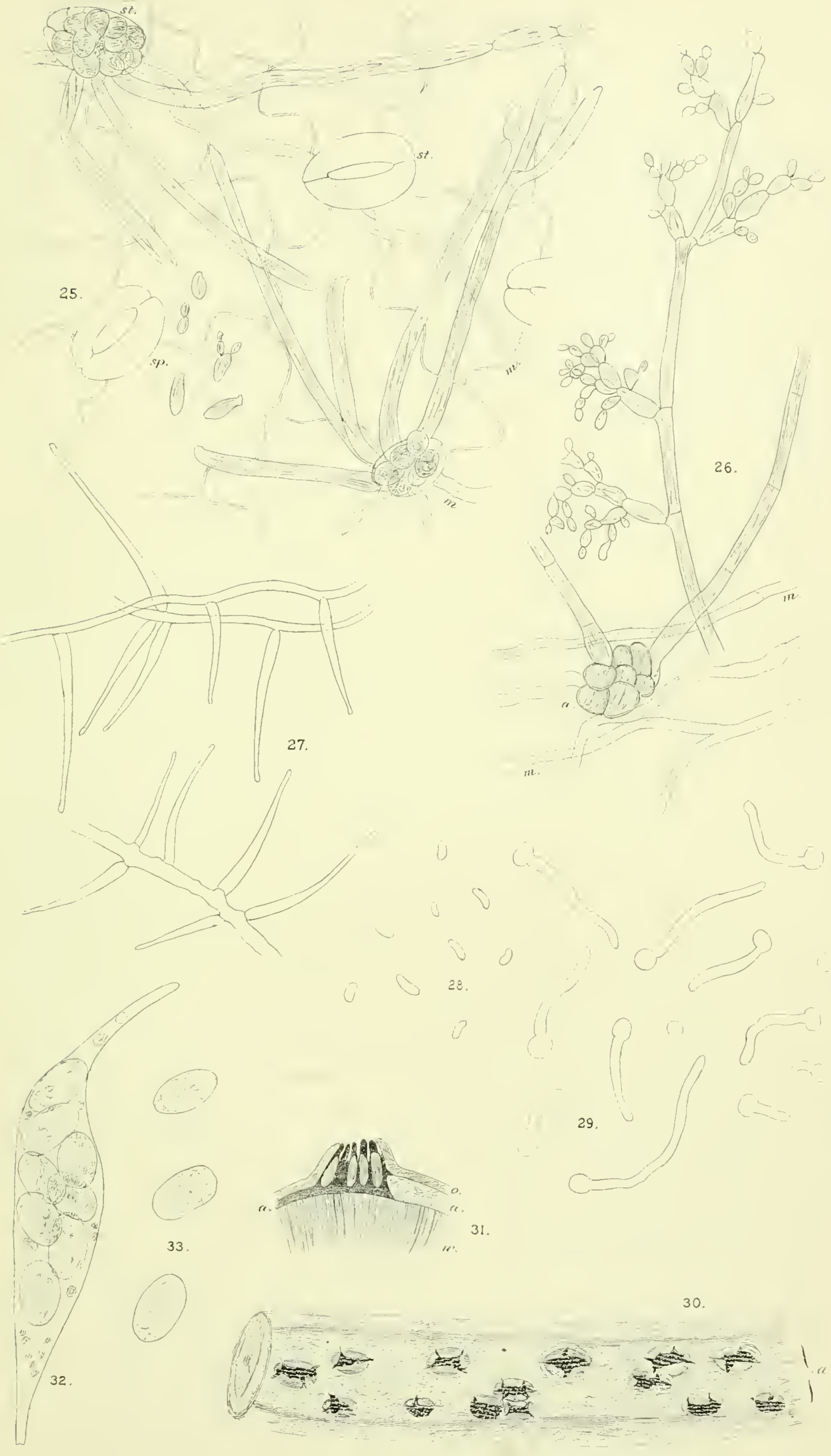
POWDERY MILDEWS.

PLATE IV.



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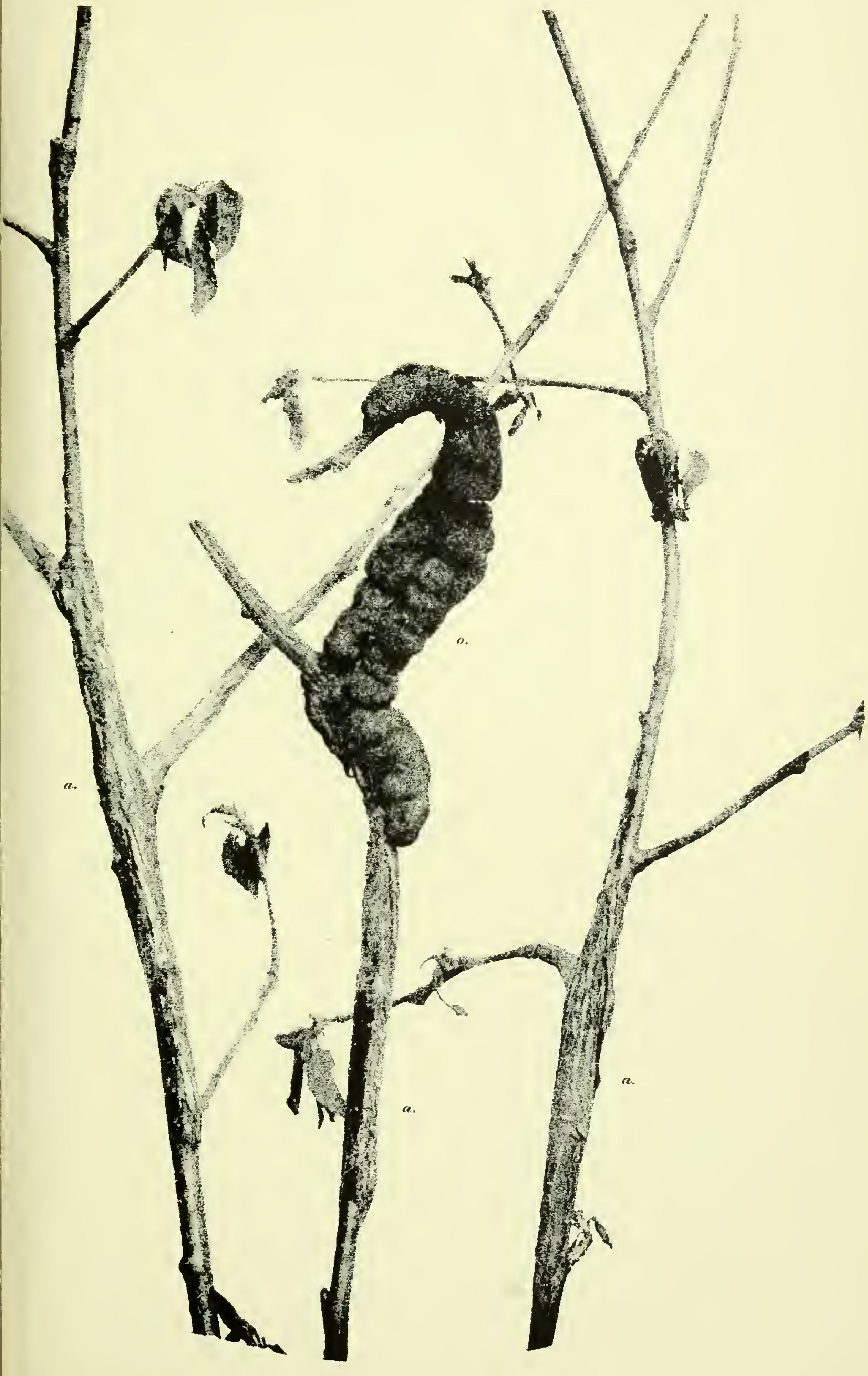
CUCUMBER DISEASES. — HAZEL FUNGUS.



BLACK KNOT OF PLUM.

PART III.

SPECIAL WORK IN THE CHEMICAL LABORATORY.

I. Communication on Commercial Fertilizers: —
  1. General Introduction.
  2. State Laws for the Regulation of Trade in Commercial Fertilizers.
  3. List of Licensed Manufacturers and Dealers from May 1, 1892, to May 1, 1893 (51).
  4. Analyses of Licensed Fertilizers (185).
  5. Analyses of Commercial Fertilizers and Manurial Substances sent on for Examination (114).
  6. Miscellaneous Analyses (9).

II. Analyses of Milk sent on for Examination (113).

III. Analyses of Water sent on for Examination (109).

IV. Compilation of Analyses made at Amherst, Mass., of Agricultural Chemicals and Refuse Materials used for Fertilizing Purposes.

V. Compilation of Analyses made at Amherst, Mass., of Fodder Articles, Fruits, Sugar-producing Plants, Dairy Products, etc.

I.

COMMUNICATION ON COMMERCIAL FERTILIZERS.

1. General introduction.
2. State laws for the regulation of trade in commercial fertilizers.
3. List of licensed manufacturers and dealers from May 1, 1892, to May 1, 1893.
4. Analyses of licensed fertilizers.
5. Analyses of commercial fertilizers and manurial substances sent on for examination.
6. Miscellaneous analyses.

1. General Introduction.

The sale of commercial manurial substances, compound and simple, has been quite extensive in our State. Fifty-one manufacturers and dealers have applied and received a license for the sale of their various brands in our State. Thirty-three of them are residents of other States.

Two hundred and three samples of licensed articles have been collected in all parts of the State by a duly authorized agent of the station. One hundred and eighty-five of them have been carefully analyzed at the chemical laboratory of the station, with the following results: no sample contained all three essential constituents above the highest guarantee; sixteen samples contained two of the essential constituents above the highest guarantee; sixty-two samples contained one of the essential elements above the highest guarantee; thirty-eight samples contained all three essential elements at the lowest guarantee; sixty-four samples contained two elements at the lowest guarantee; fifty-two samples contained one element at the lowest guarantee; no sample contained all three essential elements below the stated lowest guarantee; fifteen contained two elements below the stated lowest guarantee; fifty-seven contained one element below the lowest stated guarantee. The deficiency in one or two essential constituents was in the majority of instances compensated for by an excess in the others.

The variations in the market price of the various prominent fertilizer constituents have been, on the whole, during the past year within the usual limits. Phosphoric acid in all forms has been offered at a somewhat lower cost towards the close of the year, while that of nitrogen in its leading forms has somewhat advanced.

The duties assigned to the director of the station, to act as inspector of commercial fertilizers, render it necessary to *discriminate*, in official publications of the results of analyses of commercial fertilizers and of manurial substances in general made at the station, *between analyses of samples collected by a duly qualified delegate of the experiment station, in conformity with the rules prescribed by the new laws, and those analyses which are made of samples sent on for that purpose by outside parties.* In regard to the former alone can the director assume the responsibility of a carefully prepared sample, and of the identity of the article in question.

The official report of analyses of compound fertilizers and of all such materials as are to be used for manurial purposes, which are sold in this State under a certificate of compliance with the present laws for the regulation of the trade in these articles, has been restricted by our State laws to a statement of chemical composition and to such additional information as relates to the latter.

The practice of affixing to each analysis of this class of fertilizers an approximate commercial valuation per ton of their principal constituents has, therefore, been discontinued. This change, it is expected, will tend to direct the attention of the consumers of fertilizers more forcibly towards a *consideration of the particular composition of the different brands of fertilizers offered for their patronage, a circumstance not infrequently overlooked.*

The *approximate market value* of the different brands of fertilizers obtained by the current mode of valuation does not express *their respective agricultural value*, i. e., their crop-producing value; for the higher or lower market price of different brands of fertilizers does not necessarily stand in a direct relation to their particular fitness, without any reference to the particular condition of the soil to be treated and the special wants of the crops to be raised by their assistance.

To select judiciously from among the various brands of fertilizers offered for patronage requires, in the main, two kinds of information; namely, we ought to feel confident that the particular brand of fertilizer in question actually contains the guaranteed quantities and qualities of essential articles of plant food at a reasonable cost, and that it contains them in such form and such proportions as will best meet existing circumstances and special wants. In some cases it may be mainly either phosphoric acid or nitrogen or potash; in others, two of them; and in others again, all three. A remunerative use of commercial fertilizers can only be secured by attending carefully to the above-stated considerations.

To assist farmers not yet familiar with the current mode of determining the commercial value of manurial substances offered for sale in our markets, some of the essential considerations, which serve as a basis for their commercial valuation, are once more stated within a few subsequent pages.

The hitherto customary valuation of manurial substances is based on the average trade value of the essential fertilizing elements specified by analysis. The money value of the higher grades of agricultural chemicals and of the higher-priced compound fertilizers depends, in the majority of cases, on the amount and the particular form of two or three essential articles of plant food, i. e., phosphoric acid, nitrogen and potash, which they contain. To ascertain by this mode of valuation the approximate market value of a fertilizer (i. e., the money worth of its essential fertilizing ingredients), we multiply the pounds per ton of nitrogen, etc., by the trade value per pound; the same course is adopted with reference to the various forms of phosphoric acid and of potassium oxide. We thus get the values per ton of the several ingredients, and, adding them together, we obtain the total valuation per ton in case of cash payment at points of general distribution.

The market value of low-priced materials used for manurial purposes, as salt, wood ashes, various kinds of lime, barn-yard manure, factory refuse and waste materials of different description, quite frequently does not stand in a close relation to the market value of the amount of essential articles of plant food they contain. Their cost varies in different localities. Local facilities for cheap transportation, and more or less advantageous mechanical condition for a speedy action, exert, as a rule, a decided influence on their selling price.

The mechanical condition of any fertilizing material, simple or compound, deserves the most serious consideration of farmers, when articles of a similar chemical character are offered for their choice. The degree of pulverization controls, almost without exception, under similar conditions, the rate of solubility, and the more or less rapid diffusion of the different articles of plant food throughout the soil.

The state of moisture exerts a no less important influence on the pecuniary value in case of one and the same kind of substance. Two samples of fish fertilizers, although equally pure, may differ from fifty to one hundred per cent. in commercial value on account of mere difference in moisture.

Crude stock for the manufacture of fertilizers, and refuse materials of various descriptions, have to be valued with reference to the market price of their principal constituents, taking into consideration at the same time their general fitness for speedy action.

Trade Values of Fertilizing Ingredients in Raw Materials and Chemicals (1892).

	Cents per Pound.
Nitrogen in ammoniates,	17.5
Nitrogen in nitrates,	15.
Organic nitrogen in dry and fine ground fish, meat, blood,	16.
Organic nitrogen in cotton-seed meal and castor pomace,	15.
Organic nitrogen in fine-ground bone and tankage,	15.
Organic nitrogen in fine-ground medium bone and tankage,	12.
Organic nitrogen in medium bone and tankage,	9.5
Organic nitrogen in coarser bone and tankage,	7.5
Organic nitrogen in hair, horn shavings and coarse fish scraps,	7.
Phosphoric acid soluble in water,	7.5
Phosphoric acid soluble in ammonium citrate,	7.
Phosphoric acid in dry ground fish, fine bone and tankage,	7.
Phosphoric acid in fine medium bone and tankage,	5.5
Phosphoric acid in medium bone and tankage,	4.5
Phosphoric acid in coarse bone and tankage,	3.
Potash as high-grade sulphate, and in forms free from muriate or chlorides, ashes, etc.,	5.5
Potash as kainite,	4.5
Potash as muriate,	4.5

The organic nitrogen in *superphosphates, special manures and mixed fertilizers of a high grade* is usually valued at the highest figures laid down in the trade values of fertilizing ingredients in raw materials, namely, fifteen and a half cents per pound; it being assumed that the organic nitrogen is derived from the best sources, viz., animal matter, as meat, blood, bones, or other equally good forms, and not from leather, shoddy, hair, or any low-priced, inferior form of vegetable matter, unless the contrary is ascertained. The insoluble phosphoric acid is valued in this connection at two cents.

The above trade values are the figures at which, in the six months preceding March, 1891, the respective ingredients could be bought at *retail for cash in our large markets, in the raw materials*, which are the regular source of supply.

They also correspond to the average wholesale prices for the six months ending March 1, plus about twenty per cent.

in case of goods for which we have wholesale quotations. The valuations obtained by use of the above figures will be found to agree fairly with the retail price at the large markets of standard raw materials, such as: —

Sulphate of ammonia,
Nitrate of soda,
Muriate of potash,
Sulphate of potash,
Dried blood,
Dried ground meat,
Dry ground fish,
Azotin,
Ammonite,
Castor pomace,
Bone and tankage,
Plain superphosphates.

A large percentage of commercial materials consists of refuse matter from various industries. The composition of these substances depends on the mode of manufacture carried on. The rapid progress in our manufacturing industries is liable to affect at any time, more or less seriously, the composition of the refuse. To assist the farming community in a clear and intelligent appreciation of the various substances sold for manurial purposes, a frequent examination into the temporary characters of agricultural chemicals and refuse materials offered in our markets for manurial purposes is constantly carried on at the laboratory of the station.

Consumers of commercial manurial substances do well to buy, whenever practicable, on guarantee of composition with reference to their essential constituents, and to see to it that the bill of sale recognizes that point of the bargain. Any mistake or misunderstanding in the transaction may be readily adjusted, in that case, between the contending parties. The responsibility of the dealer ends with furnishing an article corresponding in its composition with the lowest stated quantity of each specified essential constituent.

Our present laws for the regulation of the trade in commercial fertilizers include not only the various brands of compound fertilizers, but also all materials, single or compound, without reference to source, used for manurial purposes when offered for sale in our market at ten dollars or more per ton. Copies of our present laws for the regulation of the trade in commercial fertilizers may be had by all interested, on application, at the Massachusetts State Agricultural Experiment Station, Amherst, Mass.

2. THE PROVISIONS OF THE ACT ARE AS FOLLOWS:

[CHAPTER 296.]

AN ACT TO REGULATE THE SALE OF COMMERCIAL FERTILIZERS.

Be it enacted, etc., as follows:

SECTION 1. Every lot or parcel of commercial fertilizer or material used for manurial purposes sold, offered or exposed for sale within this Commonwealth, the retail price of which is ten dollars or more per ton, shall be accompanied by a plainly printed statement clearly and truly certifying the number of net pounds of fertilizer in the package, the name, brand or trade mark under which the fertilizer is sold, the name and address of the manufacturer or importer, the place of manufacture, and a chemical analysis stating the percentage of nitrogen or its equivalent in ammonia, of potash soluble in distilled water, and of phosphoric acid in available form soluble in distilled water and reverted, as well as the total phosphoric acid. In the case of those fertilizers which consist of other and cheaper materials, said label shall give a correct general statement of the composition and ingredients of the fertilizer it accompanies.

SECT. 2. Before any commercial fertilizer, the retail price of which is ten dollars or more per ton, is sold, offered or exposed for sale, the importer, manufacturer or party who causes it to be sold or offered for sale within the state of Massachusetts, shall file with the director of the Massachusetts agricultural experiment station, a certified copy of the statement named in section one of this act, and shall also deposit with said director at his request a sealed glass jar or bottle, containing not less than one pound of the fertilizer, accompanied by an affidavit that it is a fair average sample thereof.

SECT. 3. The manufacturer, importer, agent or seller of any brand of commercial fertilizer or material used for manurial purposes, the retail price of which is ten dollars or more per ton, shall pay for each brand, on or before the first day of May annually, to the director of the Massachusetts agricultural experiment station, an analysis fee of five dollars for each of the three following fertilizing ingredients: namely, nitrogen, phosphorus and potassium, contained or claimed to exist in said brand or fertilizer: *provided*, that whenever the manufacturer or importer shall have paid the fee herein required for any person acting as agent or seller for such manufacturer or importer, such agent or seller shall not be required to pay the fee named in this section; and on receipt of said analysis fees and statement specified in section two, the director of said station shall issue certificates of compliance with this act.

Sect. 4. No person shall sell, offer or expose for sale in the state of Massachusetts, any pulverized leather, raw, steamed, roasted, or in any form as a fertilizer, or as an ingredient of any fertilizer or manure, without an explicit printed certificate of the fact, said certificate to be conspicuously affixed to every package of such fertilizer or manure and to accompany or go with every parcel or lot of the same.

Sect. 5. Any person selling, offering or exposing for sale, any commercial fertilizer without the statement required by the first section of this act, or with a label stating that said fertilizer contains a larger percentage of any one or more of the constituents mentioned in said section than is contained therein, or respecting the sale of which all the provisions of the foregoing section have not been fully complied with, shall forfeit fifty dollars for the first offence, and one hundred dollars for each subsequent offence.

Sect. 6. This act shall not affect parties manufacturing, importing or purchasing fertilizers for their own use, and not to sell in this state.

Sect. 7. The director of the Massachusetts agricultural experiment station shall pay the analysis fees, as soon as received by him, into the treasury of the station, and shall cause one analysis or more of each fertilizer or material used for manurial purposes to be made annually, and publish the results monthly, with such additional information as circumstances advise: *provided*, such information relates only to the composition of the fertilizer or fertilizing material inspected. Said director is hereby authorized in person or by deputy to take a sample, not exceeding two pounds in weight, for analysis, from any lot or package of fertilizer or any material used for manurial purposes which may be in the possession of any manufacturer, importer, agent or dealer; but said sample shall be drawn in the presence of said party or parties in interest or their representative, and taken from a parcel or a number of packages which shall be not less than ten per cent. of the whole lot inspected, and shall be thoroughly mixed and then divided into two equal samples and placed in glass vessels and carefully sealed and a label placed on each, stating the name or brand of the fertilizer or material sampled, the name of the party from whose stock the sample was drawn and the time and place of drawing, and said label shall also be signed by the director or his deputy and by the party or parties in interest or their representatives present at the drawing and sealing of said sample; one of said duplicate samples shall be retained by the director and the other by the party whose stock was sampled. All parties violating this act shall be prosecuted by the director of said station; but it shall be the duty of said director, upon ascertaining any violation of this act, to forthwith notify the manufacturer or importer in writing, and give him not less than thirty days thereafter in which to comply with the requirements of this act, but there shall be no prosecution in relation to the quality of the fertilizer or fertilizing material if the same shall be found substantially equivalent to the statement of analysis made by the manufacturer or importer.

SECT. 8. Sections eleven to sixteen inclusive of chapter sixty of the Public Statutes are hereby repealed.

SECT. 9. This act shall take effect on the first day of September in the year eighteen hundred and eighty-eight. [*Approved May 3, 1888.*]

Instructions to Manufacturers, Importers, Agents and Sellers of Commercial Fertilizers or Materials used for Manurial Purposes in Massachusetts.

1. An application for a certificate of compliance with the regulations of the trade in commercial fertilizers and materials used for manurial purposes in this State must be accompanied: —

First, with a distinct statement of the name of each brand offered for sale.

Second, with a statement of the amount of phosphoric acid, of nitrogen and of potassium oxide guaranteed in each distinct brand.

Third, with the fee charged by the State for a certificate, which is five dollars for each of the following articles, nitrogen, phosphoric acid and potassium oxide, guaranteed in any distinct brand.

2. The obligation to secure a certificate applies not only to compound fertilizers but to all substances, single or compound, used for manurial purposes, and offered for sale at ten dollars or more per ton of two thousand pounds.

3. The certificate must be secured annually before the first of May.

4. Manufacturers, importers and dealers in commercial fertilizers can appoint in this State as many agents as they

desire, after having secured at this office the certificate of compliance with our laws.

5. Agents of manufacturers, importers and dealers in commercial fertilizers are held personally responsible for their transactions until they can prove that the articles they offer for sale are duly recorded in this office.

6. Manufacturers and importers are requested to furnish a list of their agents.

7. All applications for certificates should be addressed to the Director of the Massachusetts State Agricultural Experiment Station.

Arrangements are made, as in previous years, to attend to the examination of objects of general interest to the farming community, to the full extent of existing resources. Requests for analyses of substances — as fodder articles, fertilizers, etc. — coming through officers of agricultural societies and farmers' clubs within the State will receive hereafter, as in the past, first attention, and in the order that the applications arrive at the office of the station. The results will be returned without a charge for the services rendered. Application of private parties for analyses of substances, free of charge, will receive a careful consideration whenever the results promise to be of a more general interest. For obvious reasons, no work can be carried on at the station of which the results are not at the disposal of the managers for publication, if deemed advisable in the interest of the citizens of the State.

All parcels and communications sent to "The Massachusetts State Experiment Station" must have express and postal charges prepaid, to receive attention.

3. LIST OF MANUFACTURERS AND DEALERS WHO HAVE SECURED CERTIFICATES FOR THE SALE OF COMMERCIAL FERTILIZERS IN THIS STATE DURING THE PAST YEAR (MAY 1, 1892, TO MAY 1, 1893), AND THE BRANDS LICENSED BY EACH.

Adams & Thomas, Springfield, Mass. : —
  Adams's Market Bone Fertilizer.

Allen Fertilizer Company, Boston, Mass. : —
  Allen Fertilizer.

Ames Fertilizer Company, Peabody, Mass. : —
  Plymouth Rock Brand.

H. J. Barker & Bro., New York, N. Y. : —
  " A. A." Ammoniated Superphosphate.
  Standard U N X L D Fertilizer.
  Special Corn Manure.
  Special Grass Manure.
  Special Potato Manure.
  Special Tobacco Manure.
  Fine Raw Ground Bone.

C. A. Bartlett, Worcester, Mass. : —
  Animal Fertilizer.
  Fine-ground Bone.

Bowker Fertilizer Company, Boston, Mass. : —
  Stockbridge Manures.
  Bowker's Ammoniated Bone Fertilizer.
  Bowker's Sure Crop Bone Phosphate.
  Bowker's Hill and Drill Phosphate.
  Bowker's Farm and Garden Phosphate.
  Bowker's Lawn and Garden Dressing.
  Bowker's Fresh Ground Bone.
  Bowker's Dry Ground Fish.
  Bowker's Fish and Potash.
  Gloucester Fish and Potash.
  Breck's Lawn and Garden Dressing.
  Dried Blood.
  Dissolved Bone-black.
  Nitrate of Soda.
  Muriate of Potash.
  Sulphate of Potash.

Bradley Fertilizer Company, Boston, Mass. : —
- X. L. Superphosphate of Lime.
- B. D. Sea-fowl Guano.
- Original Coe's Superphosphate.
- Farmer's New-method Fertilizer.
- English Lawn Dressing.
- High-grade Tobacco Manure.
- Bradley's Complete Manures : —
  - For Corn and Grain.
  - For Potatoes and Vegetables.
  - For Top-dressing Grass and Grain.
- Bradley's Potato Manure.
- Pure Fine-ground Bone.
- Fish and Potash.
- Dissolved Bone-black.
- Nitrate of Soda.
- Sulphate of Ammonia.
- Muriate of Potash.
- Sulphate of Potash.

W. J. Brightman & Co., Tiverton, R. I. : —
- Dry Ground Fish.
- Fish and Potash.
- Superphosphate.

Bryant & Brett, New Bedford, Mass. : —
- Ground Bone.

Burgess & Roy, South Attleborough, Mass. : —
- Animal Fertilizer.

Joseph Church & Co., Tiverton, R. I. : —
- Pure Dry Ground Fish (A Brand).
- Special Fertilizer (B Brand).
- Standard Fertilizer (C Brand).
- Fish and Potash (D Brand).

Clark Cove Fertilizer Company, Boston, Mass. : —
- Bay State Fertilizer.
- Bay State Fertilizer, G. G.
- Great Planet Manure.
- King Philip Guano.
- Potato and Tobacco Fertilizer.
- Fish and Potash.

Cleveland Dryer Company, Boston, Mass. : —
- Cleveland Potato Phosphate.
- Cleveland Superphosphate.

Cleveland Linseed Oil Company, Worcester, Mass. : —
 Cleveland Steam-cooked Linseed Meal.

E. Frank Coe, New York, N. Y. : —
 Excelsior Gold Brand Guano.
 High-grade Ammoniated Bone Superphosphate.
 Fish Guano and Potash.
 Potato Fertilizer.

Crocker Fertilizer and Chemical Company, Buffalo, N. Y. : —
 New Rival Ammoniated Superphosphate.
 Ammoniated Bone Superphosphate.
 Ammoniated Practical Superphosphate.
 Vegetable Bone Superphosphate.
 Buffalo Superphosphate, No. 2.
 Wheat and Corn Phosphate.
 Potato, Hop and Tobacco Phosphate.
 Special Potato Manure.
 Ground Bone Meal.
 Pure Ground Bone.

Cumberland Bone Phosphate Company, Portland, Me. : —
 Cumberland Superphosphate.
 Potato Fertilizer.

L. B. Darling Fertilizer Company, Pawtucket, R. I. : —
 Darling's Animal Fertilizer.
 Darling's Fertilizer for Gardens and Lawns.
 Darling's Potato and Root Crop Manure.
 Darling's Tobacco Grower.
 Darling's Extra Bone Phosphate.
 Darling's Pure Dissolved Bone.
 Darling's Pure Fine Bone.

J. C. Dow & Co., Boston, Mass. : —
 Nitrogenous Superphosphate.
 Ground Bone Fertilizer.
 Ground Bone.

Forest City Wood Ash Company, London, Ont. : —
 Hardwood Ashes.

Wm. E. Fyfe & Co., Clinton, Mass. : —
 Canada Unleached Wood Ashes (Star Brand).

Great Eastern Fertilizer Company, Rutland, Vt. : —
 Great Eastern General, for Grass and Grain.
 Great Eastern Vegetable, Vine and Tobacco Fertilizers.
 Great Eastern General, Oats, Buckwheat and Seeding-down Phosphate.

Hargraves' Manufacturing Company, Fall River, Mass. : —
Ground Bone.

Edmund Hersey, Hingham, Mass. : —
Ground Bone.

Thos. Hersom & Co., New Bedford, Mass. : —
Meat and Bone.
Pure Fine-ground Bone.

Gilbert E. Holmes, New Worcester, Mass. : —
Pure Ground Bone.

John G. Jefferds, Worcester, Mass. : —
Animal Fertilizer.
Potato Manure.
Fine-ground Bone.

J. J. Joynt, St. Helens, Ont. : —
Canada Unleached Hardwood Ashes.

A. Lee & Co., Boston, Mass. : —
Lawrence Fertilizer.
Ground Bone.

Lowell Bone Fertilizer Company, Lowell, Mass. : —
Lowell Bone Fertilizer.

James E. McGovern, West Andover, Mass. : —
West Andover Market Bone Phosphate.
Ground Bone.

Mapes Formula and Peruvian Guano Company, New York, N. Y. : —
Mapes Superphosphates.
Mapes Special Crop Manures.
Peruvian Guanos.
Bone Manures.
Sulphate of Potash.

Monroe, DeForest & Co., Oswego, N. Y. : —
Hardwood Ashes.

National Fertilizer Company, Bridgeport, Conn. : —
Chittenden's Complete Fertilizer.
Chittenden's Universal Phosphate.
Chittenden's Fish and Potash.
Ground Bone.
Sulphate of Potash.

Pacific Guano Company, Boston, Mass. : —
Soluble Pacific Guano.
Special Potato Manure.

Prentiss, Brooks & Co., Holyoke, Mass. : —
- Complete Manure.
- Phosphate.
- Dry Fish.
- Dissolved Bone-black.
- Nitrate of Soda.
- Muriate of Potash.

Quinnipiac Fertilizer Company, Boston, Mass. : —
- Quinnipiac Market-garden Manure.
- Quinnipiac Corn Manure.
- Quinnipiac Potato Manure.
- Quinnipiac Potato and Tobacco Fertilizer.
- Quinnipiac Havana and Seed-leaf Tobacco Fertilizer.
- Quinnipiac Onion Manure.
- Quinnipiac Phosphate.
- Quinnipiac Pure Bone Meal.
- Quinnipiac Dry Ground Fish.
- Quinnipiac Fish and Potash (c. f. Brand).
- Quinnipiac Fish and Potash (Plain Brand).
- Muriate of Potash.
- Sulphate of Potash.

Benjamin Randall, East Boston, Mass. : —
- Market-garden Fertilizer.
- Standard Ground Bone.

Read Fertilizer Company, Syracuse, N. Y. : —
- H. G. Farmers' Friend.
- Strawberry and Small Fruit Special.
- Read's Standard Phosphate.
- Bone, Fish and Potash (Fish and Potash).

John S. Reese & Co., Baltimore, Md. : —
- New England Favorite.
- May Flower.
- Columbus, A.
- Pilgrim.
- Potato Special.
- Fish and Potash.

Lucien Sanderson, New Haven, Conn. : —
- Sanderson's Formula A.
- Sanderson's Formula B.
- Sanderson's High-grade Sulphate of Potash.
- Sanderson's Regular Sulphate of Potash.

Edward H. Smith, Northborough, Mass. : —
- Steamed Bone.

Springfield Fertilizer Company, Springfield, Mass. : —
H. L. Phelps' Complete Manures.

Springfield Provision Company, Brightwood, Mass. : —
Blood, Meat and Bone.

Standard Fertilizer Company, Boston, Mass. : —
Standard Superphosphate.
Standard Fertilizer.
Standard Guano.
Potato and Tobacco Fertilizer.

F. C. Sturtevant, Hartford, Conn. : —
Tobacco and Sulphur Fertilizer.

J. A. Tucker & Co., Boston, Mass. : —
Original Bay State Bone Superphosphate.
Imperial Bone Superphosphate.

Whittemore Bros., Wayland, Mass. : —
Whittemore's Complete Manure.

Sanford Winter, Brockton, Mass. : —
Pure Ground Bone.

Leander Wilcox, Mystic, Conn. : —
Ammoniated Bone Phosphate.
High-grade Fish and Potash.
Potato, Onion and Tobacco Manure.
Dry Ground Fish.

William & Clark Fertilizer Company, Boston, Mass. : —
Ammoniated Bone Superphosphate.
Universal Ammoniated Dissolved Bone.
High-grade Special.
Potato and Tobacco Manure.
Fine Wrapper Tobacco Grower.
Potato Phosphate.
Corn Phosphate.
Pure Bone Meal.
Dry Ground Fish.
Fish and Potash.
Nitrate of Soda.
Muriate of Potash.
Sulphate of Potash.

4. ANALYSES OF LICENSED FERTILIZERS COLLECTED DURING 1892 IN THE GENERAL MARKETS BY THE AGENT OF THE MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

Laboratory Number.	NAME OF BRAND.	NAME OF MANUFACTURER.	Sampled at —
	Compound Fertilizers.		
2	Special Tobacco Manure,	H. J. Baker & Bro., New York, N. Y.,	Northampton.
12	Dry Ground Fish,	Williams & Clark, Boston, Mass.,	Northampton.
34	Jefferds' Potato Manure,	John G. Jefferds, Worcester, Mass.,	Worcester.
40	Dry Fish Guano,	Bradley Fertilizer Company, Boston, Mass.,	North Amherst.
50	Fine-ground Dry Fish,	Bowker Fertilizer Company, Boston, Mass.,	Sunderland.
58	Jefferds' Potato Manure,	John G. Jefferds, Worcester, Mass.,	Hadley.
59	Jefferds' Animal Fertilizer,	John G. Jefferds, Worcester, Mass.,	Hadley.
87	Crocker's Wheat and Corn Phosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Lee.
90	Pacific Guano Company's Special Potato Manure,	W. D. Stewart, Boston, Mass.,	Pittsfield.
97	Crocker's Wheat and Corn Phosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	North Adams.
108	Bay State Fertilizer,	Clark's Cove Fertilizer Company, Boston, Mass.,	Dighton.
	Chemicals.		
32	Muriate of Potash,	Bowker Fertilizer Company, Boston, Mass.,	Worcester.
33	Nitrate of Soda,	Bowker Fertilizer Company, Boston, Mass.,	Worcester.
64	Nitrate of Soda,	Bowker Fertilizer Company, Boston, Mass.,	Amherst.
65	Muriate of Potash,	Bowker Fertilizer Company, Boston, Mass.,	Amherst.
75	Dissolved Bone-black,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
119	Muriate of Potash,	Bradley Fertilizer Company, Boston, Mass.,	New Bedford.
146	Nitrate of Soda,	Williams & Clark, Boston, Mass.,	Greenfield.
148	Muriate of Potash,	Williams & Clark, Boston, Mass.,	Greenfield.
	Bones.		
7	H. J. Baker & Bro.'s Raw Ground Bone,	H. J. Baker & Bro., New York, N. Y.,	Northampton.
24	H. J. Baker & Bro.'s Raw Ground Bone,	H. J. Baker & Bro., New York, N. Y.,	Springfield.
35	Jefferds' Fine-ground Bone,	John G. Jefferds, Worcester, Mass.,	Worcester.
37	Bartlett's Fine-ground Bone,	C. A. Bartlett, Worcester, Mass.,	Worcester.
60	Steamed Bone,	E. H. Smith, Northborough, Mass.,	Amherst.
161	Darling's Ground Bone,	L. B. Darling Fertilizer Company, Pawtucket, R. I.,	Fitchburg.
	Wood Ashes.		
144	Canada Unleached Hardwood Ashes,	Monroe, DeForest & Co., Oswego, N. Y.,	South Deerfield.

4. ANALYSES OF LICENSED FERTILIZERS, ETC. — *Continued.*

Laboratory Number.	NAME OF BRAND.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.			
								TOTAL.		AVAILABLE.					
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.		
	Compound Fertilizers.														
2	Special Tobacco Manure,	8.52	4.36	4.53	5.12	.05	.20	5.37	-	5.17	4	9.56	10*		
12	Dry Ground Fish,	7.30	7.96	7.41—9.06	.18	3.56	4.09	7.83	7—8	3.74	-	-	-		
34 58	Jefferds' Potato Manure,	7.74	2.48	2.47—3.30	4.81	5.68	3.74	14.23	15—17	10.49	10—12	6.09	5—6*		
40	Dry Fish Guano,	10.34	8.27	7.41—9.06	.82	3.30	3.17	7.29	7—9	4.12	-	-	-		
50	Fine-ground Dry Fish,	10.12	8.64	6.59—8.24	.61	3.97	2.61	7.19	7—8	4.58	-	-	-		
59	Jefferds' Animal Fertilizer,	11.30	2.95	2.47—3.30	4.38	14.17	4.63	23.18	16—18	18.55	11—13	3.16	2.50—3.50*		
87 97	Crocker's Wheat and Corn Phosphate,	13.22	2.34	2—3	6.35	4.31	1.64	12.60	11—15	10.66	10—13	2.95	1.80—2.70*		
90	Special Potato Manure,	13.34	2.67	2.47—3.30	4.35	1.28	2.81	8.44	7—10	5.63	5—7	5.12	5—6		
108	Bay State Fertilizer,	13.03	2.68	2.47—3.30	7.57	2.51	2.61	12.69	10—14	10.08	9—12	2.26	2—3*		
	Chemicals.														
32 65	Muriate of Potash,	1.94	-	-	-	-	-	-	-	-	-	50.65	50.34—53.70		
33 64	Nitrate of Soda,	1.10	15.44	15.65—16.14	-	-	-	-	-	-	-	-	-		
75	Dissolved Bone-black,	13.73	-	-	16.67	.30	.23	17.22	-	16.97	16—17	-	-		
119	Muriate of Potash,	1.26	-	-	-	-	-	-	-	-	-	50.40	48—55		
146	Nitrate of Soda,	1.02	15.52	15.65—16.14	-	-	-	-	-	-	-	-	-		
148	Muriate of Potash,	1.04	-	-	-	-	-	-	-	-	-	51.10	50.54—53.70		
												Mechanical Analysis.			
	Bones.											Fine.	Fine Med.	Med.	Coarse Med.
7 24	Fine Raw Ground Bone,	8.53	3.77	3.30—3.91	.19	7.27	17.97	25.43	22—26	7.46	-	42.84	56.30	.70	.16
35	Fine-ground Bone,	9.00	1.51	2.47—3.30	.31	13.02	16.58	29.91	27—30	13.33	-	64.20	31.05	4.75	-
37	Fine-ground Bone,	3.95	3.60	2.39	.82	10.74	13.41	24.97	27.35	11.56	-	55.92	33.00	10.01	1.07
60	Steamed Bone,	5.24	4.00	4.02	.31	8.44	14.38	23.13	23.50	8.75	7.69	44.03	44.64	11.33	-
161	Fine-ground Bone,	3.40	2.84	2.47—3.30	.26	10.69	14.25	25.20	24—26	10.95	-	75.12	16.52	7.36	-
												Potassium Oxide.			
	Wood Ashes.											Found.	Guaranteed.		
144	Canada Unleached Hardwood Ashes,	11.27	-	-	-	-	-	1.30	1—2.50	-	-	5.42	4.50—7		

* Sulphate of potash, the source of potash.

4. Analyses of Licensed Fertilizers, etc. — *Continued.*

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at —
	Compound Fertilizers.		
56	Darling's Animal Fertilizer,	L. B. Darling Fertilizer Company, Pawtucket, R. I.,	Sunderland.
179	High-grade Ammoniated Bone Superphosphate,	E. Frank Coe, New York, N. Y.,	Hadley.
141	Tobacco Manure (Wrapper Brand),	Mapes' Formula and Peruvian Guano Company, New York, N. Y.,	South Deerfield.
188	Blood, Meat and Bone,	Springfield Provision Company, Brightwood, Mass.,	Brightwood.
197	Potato, Onion and Tobacco Manure,	Leander Wilcox, Mystic, Conn.,	Holyoke.
101	Animal Fertilizer (Darling's),	L. B. Darling Company, Pawtucket, R. I.,	Worcester.
85	High-grade Ammoniated Bone Superphosphate,	E. Frank Coe, New York, N. Y.,	Lee.
94	Great Eastern Vegetable, Vine and Tobacco Fertilizer,	Great Eastern Fertilizer Company, Rutland, Vt.,	Pittsfield.
81	Potato Manure,	Quinnipiac Fertilizer Company, Boston, Mass.,	Springfield.
100	Onion Manure,	Quinnipiac Fertilizer Company, Boston, Mass.,	South Deerfield.
151	Standard Fertilizer,	Standard Fertilizer Company, Boston, Mass.,	Greenfield.
48	Cumberland Superphosphate,	Cumberland Bone Company, Portland, Me.,	Sunderland.
129	Ammoniated Practical Superphosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Amherst.
45	Potato Manure,	Quinnipiac Fertilizer Company, Boston, Mass.,	North Amherst.
26	Fish and Potash, D Brand,	Joseph Church & Co., Tiverton, R. I.,	Springfield.
153	May Flower,	John S. Reese & Co. Baltimore, Md.,	Greenfield.
18	Bradley's X. L. Superphosphate of Lime,	Bradley Fertilizer Company, Boston, Mass.,	Northampton.
106	Fish and Potash, D Brand,	Joseph Church & Co., Tiverton, R. I.,	Taunton.
103	Cleveland Potato Phosphate,	Cleveland Dryer Company, Cleveland, Ohio.,	So. Framingham.
42	Bradley's X. L. Superphosphate of Lime,	Bradley Fertilizer Company, Boston, Mass.,	North Amherst.
164	Superphosphate (Cumberland),	Cumberland Bone Company, Portland, Me.,	Lowell.
109	New England Favorite,	J. S. Reese & Co., Baltimore, Md.,	Dighton.
	Bones.		
86	Pure Ground Bone,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Lee.
128	Pure Ground Bone,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Amherst.
120	Pure Fine-ground Bone,	Thos. Hersom & Co., New Bedford, Mass.,	New Bedford.
167	Pure Fine-ground Bone,	Thos. Hersom & Co., New Bedford, Mass.,	New Bedford.

4. Analyses of Licensed Fertilizers, etc. — *Continued.*

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
								total.		available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
56 101	Darling's Animal Fertilizer,	18.27	3.40	3.30—4.90	4.55	2.62	4.50	11.67	10—12	7.17	-	4.49	4—6
179 85	High-grade Ammoniated Bone Superphosphate,	11.37	2.34	2—2.50	7.23	1.41	2.43	11.07	11—13	8.64	9—12	2.24	2*
141	Tobacco Manure (Wrapper Brand),	8.57	6.02	6.18	.45	2.43	3.26	6.14	4.50	2.88	-	11.69	10.50*
188	Blood, Meat and Bone,	8.76	7.18	7.76	51	4.61	4.86	9.98	10.66	5.12	-	-	-
197	Potato, Onion and Tobacco Manure,	7.05	3.91	3.25—4.25	6.65	1.22	2.94	10.81	8—9	7.87	7—8	5.72	6—7
94	Great Eastern Vegetable, Vine and Tobacco Fertilizer,	13.90	2.14	2.06—2.88	7.04	1.15	1.34	9.53	9—15	8.19	8—12	6.10	6—8
81 45	Potato Manure,	13.72	3.18	2.47—3.30	4.09	1.80	2.43	8.32	7—11	5.89	6—9	4.37	5—6*
100	Onion Manure,	10.52	3.65	3.30—4.12	6.22	5.22	1.25	12.69	9—13	11.44	8—11	6.50	7—8*
151	Standard Fertilizer,	10.46	2.11	2—3	7.06	2.21	2.81	12.08	10—15	9.27	8—12	2.16	2—3
48 164	Cumberland Superphosphate,	11.64	2.20	2.06—2.88	8.39	1.28	2.56	12.23	10—12	9.67	8—10	2.28	2—3*
129	Ammoniated Practical Superphosphate,	11.62	1.27	.82—1.64	5.99	3.28	1.48	10.75	9—12	9.27	8—10	1.98	1—2*
26 106	Fish and Potash, D Brand,	13.54	2.68	2.47—3.30	4.66	2.00	1.48	8.14	7.50—8.50	6.66	-	2.25	2—3
153	May Flower,	11.86	1.91	1.80—2.50	3.07	6.44	1.18	10.69	10—13	9.51	8.50—10	2.49	2.25—3
18 42	Bradley's X. L. Superphosphate of Lime,	13.48	2.97	2.50—3.25	6.91	4.86	1.48	13.25	11—13	11.77	9—11	2.19	2—3*
103	Cleveland Potato Phosphate,	7.57	2.52	2.05—2.85	7.42	2.10	1.33	10.85	10—13	9.52	8—10	4.01	3—4*
109	New England Favorite,	17.54	2.58	2.47—3.30	3.84	7.16	.51	11.51	11—14	11.00	9—12	2.37	2—3
												Mechanical Analysis.	
	Bones.											Fine. / Fine Med.	Med. / Coarse Med.
86 128	Pure Ground Bone,	7.48	3.51	2—3.70	.24	7.05	16.76	24.05	25.00	7.29	-	26.20 25.78	39.39 8.63
120 167	Pure Fine-ground Bone,	4.27	1.68	2.08	.26	10.29	20.09	30.64	29.42	10.55	13.62	59.67 22.71	15.00 2.62

* Sulphate of potash, the source of potash.

4. ANALYSES OF LICENSED FERTILIZERS, ETC. — *Continued.*

Laboratory Number.	NAME OF BRAND.	NAME OF MANUFACTURER.	Sampled at —
	Compound Fertilizers.		
8	Ammoniated Bone Superphosphate (Americus Brand),	Williams & Clark Fertilizer Company, Boston, Mass.,	Northampton.
16	Bradley's High-grade Tobacco Manure,	Bradley Fertilizer Company, Boston, Mass.,	Northampton.
23	Bowker's Lawn and Garden Dressing,	Bowker Fertilizer Company, Boston, Mass.,	Springfield.
28	Tobacco and Sulphur Lawn Fertilizer,	F. C. Sturtevant, Hartford, Conn.,	Springfield.
31	Bowker's Lawn and Garden Dressing,	Bowker Fertilizer Company, Boston, Mass.,	Worcester.
41	High-grade Tobacco Manure,	Bradley Fertilizer Company, Boston, Mass.,	North Amherst.
43	Dry Ground Fish,	Quinnipiac Fertilizer Company, Boston, Mass.,	North Amherst.
67	High-grade Fish and Potash,	Leander Wilcox, Mystic, Conn.,	Amherst.
76	Complete Manure for Corn,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
83	Ammoniated Bone Superphosphate (Americus Brand),	Williams & Clark Fertilizer Company, Boston, Mass.,	Springfield.
96	Special Potato Manure,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	North Adams.
107	Clark's Cove Fish and Potash,	Clark's Cove Fertilizer Company, Boston, Mass.,	Dighton.
112	Columbus "A" Manure,	J. S. Reese & Co., Baltimore, Md.,	Dighton.
115	Market-garden Manure,	Quinnipiac Fertilizer Company, Boston, Mass.,	Fall River.
117	Potato, Tobacco and Hop Phosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Fall River.
124	Plymouth Rock Fertilizer,	Ames Fertilizer Company, Peabody, Mass.,	Amherst.
125	Dow's Nitrogenous Superphosphate,	John C. Dow & Co., Boston, Mass.,	Amherst.
133	Special Potato Manure,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Amherst.
136	Potato, Hop and Tobacco Phosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Amherst.
166	Lowell Bone Fertilizer,	J. M. Butman, Chelmsford, Mass.,	Chelmsford.
180	Red Brand Excelsior Guano,	E. Frank Coe, New York, N. Y.,	Hadley.
193	Market-garden Manure,	Quinnipiac Fertilizer Company, Boston, Mass.,	Northampton.
195	Columbus "A" Manure,	J. S. Reese & Co., Baltimore, Md.,	Springfield.
198	Complete Manure for Corn,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
	Bones.		
52	Fresh Ground Bone,	Bowker Fertilizer Company, Boston, Mass.,	Sunderland.
113	Ground Bone,	Hargraves' Manufacturing Company, Fall River, Mass.,	Fall River.
116	Ground Bone,	Hargraves' Manufacturing Company, Fall River, Mass.,	Fall River.
121	Pure Ground Bone,	S. Winter, Brockton, Mass.,	Brockton.
138	Pure Ground Bone,	S. Winter, Brockton, Mass.,	Amherst.
169	Fine-ground Bone,	Bryant & Brett, New Bedford, Mass.,	New Bedford.

4. ANALYSES OF LICENSED FERTILIZERS, ETC. — *Continued.*

Laboratory Number.	NAME OF BRAND.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
8 83	Ammoniated Bone Superphosphate (Americens Brand),	11.44	2.78	2.47—3.80	6.14	2.92	2.35	11.41	10—13	9.06	9—11	1.53	2—3*
16 41	Bradley's High-grade Tobacco Manure,	7.32	5.92	5.77—6.59	2.25	1.02	3.28	6.55	4—5	3.27	-	10.31	10.80*
23 31	Bowker's Lawn and Garden Dressing,	14.46	4.08	4.12—4.94	5.99	.05	5.22	11.26	6—8	6.04	5—6	5.03	5—6*
28	Tobacco and Sulphur Lawn Fertilizer,	12.72	1.94	1.96	trace	.25	.26	.51	.75	.25	-	8.34	7.66
43	Dry Ground Fish,	6.38	8.72	7.41—9.06	.77	3.48	2.30	6.55	7—9	4.25	-	-	-
67	High-grade Fish and Potash,	19.44	3.66	3.25—4.25	2.97	1.43	2.25	6.65	6—7	4.40	5—6	4.93	4—5
76 198	Complete Manure for Corn,	13.92	3.36	3.30—4.12	4.75	.78	1.25	6.78	8—10	5.53	4—6	5.85	6—7
96 133	Special Potato Manure,	11.95	3.90	3.70—4.50	5.68	1.48	2.51	9.67	9—11	7.16	8—9	5.45	5.40—6.40*
107	Clark's Cove Fish and Potash,	16.34	3.44	2.47—4.12	3.38	2.20	1.89	7.47	7—9	5.58	6—8	2.73	3—5*
112 195	Columbus "A" Manure,	15.73	3.44	3.29—4.11	2.66	5.12	.77	8.55	8—11	7.78	7—9	9.06	9.50—11
115 193	Market-garden Manure,	12.94	3.82	3.30—4.12	6.55	.87	2.66	10.08	9—13	7.42	8—11	6.98	7—8*
117 136	Potato, Tobacco and Hop Phosphate,	15.01	2.56	2—3	7.42	7.17	1.41	16.00	11—14	14.59	10—12	3.87	3.25—4.30*
124	Plymouth Rock Fertilizer,	19.28	2.52	2.47—3.30	5.31	5.92	.19	11.42	9—13	11.23	8—10	3.52	3—4
125	Dow's Nitrogenous Superphosphate,	20.82	2.32	2.03—2.88	3.71	5.46	1.04	10.21	8—10	9.17	-	2.18	1.90—2.53
166	Lowell Bone Fertilizer,	13.97	2.48	2—2.50	5.76	6.01	.13	11.90	9—16.5	11.77	7—13.5	2.88	2—3.50
180	Red Brand Excelsior Guano,	12.82	3.14	3.50—4	7.16	1.86	1.02	10.04	10—14	9.02	9—12	6.47	6*

Laboratory Number.	NAME OF BRAND.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Mechanical Analysis.			
								Total.		Available.					
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Fine.	Fine Med.	Med.	Coarse Med.
	Bones.														
52	Fresh Ground Bone,	4.89	3.40	2.47—3.30	1.05	6.62	10.75	18.42	18—22	7.67	5—7	39.96	29.04	24.50	6.50
113 116	Ground Bone,	12.05	2.80	2.50—2.80	.32	11.45	13.87	25.66	25—27	11.77	-	21.28	37.86	18.48	22.38
121 138	Pure Ground Bone,	5.82	3.32	3.66	.20	11.67	10.90	22.77	22.85	11.87	9.55	59.61	20.75	8 70	10.94
169	Pure Fine-ground Bone,	6.96	2.50	2.50	.10	7.06	18.40	25.56	25.56	7.16	7.16	17.69	20.74	19.90	41.67

* Sulphate of potash, the source of potash.

4. Analyses of Licensed Fertilizers, etc. — *Continued.*

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at —
	Compound Fertilizers.		
4	Complete Grass Manure,	H. J Baker & Bro., New York, N. Y.,	Northampton.
17	Bradley's Complete Manure for Potatoes and Vegetables,	Bradley Fertilizer Company, Boston, Mass.,	Northampton.
36	Animal Fertilizer,	C. A. Bartlett, Worcester, Mass.,	Worcester.
54	Ammoniated Bone Phosphate,	Bowker Fertilizer Company, Boston, Mass.,	Sunderland.
57	Potato and Root Crop Manure,	L. B. Darling Fertilizer Company, Pawtucket, R. I.,	Sunderland.
74	Phosphate,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
82	Cleveland Steam-cooked Linseed Meal,	Cleveland Linseed Oil Company, Cleveland, Ohio,	Springfield.
91	Soluble Pacific Guano,	W. D. Stewart & Co., Boston, Mass. (Agent),	Pittsfield.
92	Chittenden's Ammoniated Bone Superphosphate,	National Fertilizer Company, Bridgeport, Conn.,	Pittsfield.
102	Potato and Root Crop Manure,	L. B. Darling Fertilizer Company, Pawtucket, R. I.,	Worcester.
110	Dry Ground Fish,	Clark's Cove Fertilizer Company, Boston, Mass.,	Dighton.
118	Chittenden's Fish and Potash,	National Fertilizer Company, Bridgeport, Conn.,	New Bedford.
122	Whittemore's Complete Manure,	Whittemore Bros., Wayland, Mass.,	Wayland.
123	Animal Fertilizer,	Burgess & Roy, South Attleborough, Mass.,	Amherst.
130	Buffalo Superphosphate, No. 2,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Amherst.
156	Standard Fertilizer,	Read Fertilizer Company, Syracuse, N. Y.,	Gardner.
157	Strawberry Special,	Read Fertilizer Company, Syracuse, N. Y.,	Gardner.
172	Lawrence Fertilizer,	A. Lee & Co., Boston, Mass.,	Lawrence.
173	West Andover Market Bone Phosphate,	J. E. McGovern, Lawrence, Mass.,	Lawrence.
183	Chittenden's Fish and Potash,	National Fertilizer Company, Bridgeport, Conn ,	Hadley.
199	Garden and Lawn Dressing,	L. B. Darling Fertilizer Company, Pawtucket, R. I.,	Amherst.
	Chemicals.		
72	Muriate of Potash,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
73	Nitrate of Potash,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
140	Sulphate of Potash,	Mapes Formula and Peruvian Guano Company, New York, N. Y.,	South Deerfield.
147	Sulphate of Potash,	Williams & Clark, Boston, Mass.,	Greenfield.
175	Sulphate of Potash,	Bowker Fertilizer Company, Boston, Mass ,	Amherst.
176	Sulphate of Potash,	Bradley Fertilizer Company, Boston, Mass.,	North Amherst.
177	Muriate of Potash,	Quinnipiac Fertilizer Company, Boston, Mass.,	North Amherst.
178	Sulphate of Potash,	Quinnipiac Fertilizer Company, Boston, Mass.,	North Amherst.
184	Sulphate of Potash,	National Fertilizer Company, Bridgeport, Conn.,	Hadley.
	Wood Ashes.		
98	Canada Unleached Hardwood Ashes,	J. J. Joynt, St. Helens, Ont.,	South Deerfield.
139	Wood Ashes,	Forest City Wood Ash Company, London, Ont.,	South Deerfield.

4. Analyses of Licensed Fertilizers, etc. — *Continued.*

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
								TOTAL.		AVAILABLE.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
4	Complete Grass Manure,	16.18	3.50	3.71	4.20	1.43	.23	5.86	-	5.63	5	8.17	7.50
17	Bradley's Com. Manure for Potatoes and Veg.,	10.20	3.98	3.75—4.50	6.91	1.93	1.02	9.86	9—12	8.84	8—11	7.69	6—7*
36	Animal Fertilizer,	6.42	3.72	3.30—4.12	3.07	3.57	5.76	12.40	16—18	6.64	-	7.73	7—8
54	Ammoniated Bone Phosphate,	12.42	1.88	1.65—2.47	5.65	3.09	2.39	11.13	10—12	8.74	8—10	2.13	2—3
57 102	Potato and Root Crop Manure,	13.55	2.36	2.88—4.12	4.09	3.33	2.56	9.98	10—12	7.42	-	7.66	7—9
74	Phosphate,	11.94	2.70	2.47—3.30	6.58	1.84	2.43	10.85	8—10	8.42	-	3.04	3—4
82	Cleveland Steam-cooked Linseed Meal,	10.85	5.95	5.80—6.20	-	-	-	2.00	1.998—2.20	-	-	1.36	1.30—1.50
91	Soluble Pacific Guano,	16.82	2.40	2.25—4.00	6.66	2.93	2.05	11.64	10.50—16	9.59	8.50—12	3.15	2—3.50*
92	Chittenden's Ammoniated Bone Superphos.,	10.72	2.44	1.65—2.47	7.83	2.10	2.15	12.08	9—11	9.93	7—9	3.27	2—4
110	Dry Ground Fish,	7.82	7.16	7.41—9.06	.97	2.67	3.58	7.22	7—9	3.64	-	-	-
118 183	Chittenden's Fish and Potash,	6.26	3.00	3.30—4.12	1.57	2.05	5.28	8.90	6—8	3.62	-	6.20	5—6
122	Whittemore's Complete Manure,	11.76	3.62	2.47—3.30	6.19	5.81	3.88	15.88	12—14	12.00	8—12	2.79	3—4
123	Animal Fertilizer,	4.00	4.20	2.47—4.12	.20	4.66	12.64	17.50	12—15	4.86	10—12	4.99	3—5
130	Buffalo Superphosphate, No. 2,	18.10	-	-	10.39	1.16	1.60	13.15	12—15	11.55	11—13	2.62	1.35—2*
156	Standard Fertilizer,	12.60	1.08	.82—1.65	5.42	2.25	.26	7.93	10—12	7.67	8—10	4.49	4—6*
157	Strawberry Special,	16.37	3.10	3.30—4.94	3.45	2.30	1.15	6.90	6—8	5.75	5—6	7.43	6—8*
172	Lawrence Fertilizer,	9.88	2.30	2.06—2.88	3.88	7.98	2.16	14.02	12	11.86	-	4.24	2—3
173	West Andover Market Bone Phosphate,	11.50	1.62	2.50—3.50	4.35	8.66	4.73	17.74	13—15	13.01	6—8	1.50	4—6
199	Garden and Lawn Dressing,	7.06	3.82	4—6	4.66	1.99	3.79	10.44	10—12	6.65	-	6.49	5—6
	Chemicals.												
72	Muriate of Potash,	.60	-	-	-	-	-	-	-	-	-	51.65	50.54—53.70
73	Nitrate of Soda,	1.72	13.88	14.82—15.52	-	-	-	-	-	-	-	-	-
140	Sulphate of Potash,	8.50	-	-	-	-	-	-	-	-	-	26.92	25.94—28.10*
147	Sulphate of Potash,	4.50	-	-	-	-	-	-	-	-	-	24.90	25.94—27.02*
175	Sulphate of Potash,	.65	-	-	-	-	-	-	-	-	-	49.60	48—52*
176	Sulphate of Potash,	3.42	-	-	-	-	-	-	-	-	-	26.35	25.94—27.02*
177	Muriate of Potash,	1.77	-	-	-	-	-	-	-	-	-	51.36	50.54—53.70
178	Sulphate of Potash,	4.82	-	-	-	-	-	-	-	-	-	25.78	25.94—27.02*
184	Sulphate of Potash,	4.53	-	-	-	-	-	-	-	-	-	24.15	25.94—27.02*
	Wood Ashes.												
98	Canada Unleached Hardwood Ashes,	13.10	-	-	-	-	-	1.77	-	-	-	4.72	5—7
139	Wood Ashes,	15.75	-	-	-	-	-	1.33	1.50—2.50	-	-	5.44	4.50—8.50

* Sulphate of potash, the source of potash.

4. ANALYSES OF LICENSED FERTILIZERS, ETC. — *Continued.*

Laboratory Number.	NAME OF BRAND.	NAME OF MANUFACTURER.	Sampled at —
	Compound Fertilizers.		
1	Pelican Bone Standard Fertilizer,	H. J. Baker & Bro., New York, N. Y.,	Northampton.
5	Potato Manure,	H. J. Baker & Bro., New York, N. Y.,	Northampton.
10	Potato Phosphate,	Williams & Clark, Boston, Mass.,	Northampton.
15	Mapes' Manure for Potatoes,	Mapes Formula and Peruvian Guano Company, New York, N. Y.,	Northampton.
27	Pure Dry Fish A Brand,	Joseph Church & Co., Tiverton, R. I.,	Springfield.
30	Bradley's Complete Manure for Top-dressing Grass, etc.,	Bradley Fertilizer Company, Boston, Mass.,	Worcester.
39	Fish and Potash, Brand B,	Bradley Fertilizer Company, Boston, Mass.,	North Amherst.
44	Fish and Potash (Crossed Fish Brand),	Quinnipiac Fertilizer Company, Boston, Mass.,	North Amherst.
46	Corn Manure,	Quinnipiac Fertilizer Company, Boston, Mass.,	North Amherst.
47	Potato and Tobacco Fertilizer,	Quinnipiac Fertilizer Company, Boston, Mass.,	North Amherst.
61	Dried Blood,	Bowker Fertilizer Company, Boston, Mass.,	Amherst.
62	Dissolved Bone-black,	Bowker Fertilizer Company, Boston, Mass.,	Amherst.
68	Dry Ground Fish Guano,	Leander Wilcox, Mystic, Conn.,	Amherst.
79	Quinnipiac Phosphate,	Quinnipiac Fertilizer Company, Boston, Mass.,	Springfield.
80	Fish and Potash (Crossed Fish Brand),	Quinnipiac Fertilizer Company, Boston, Mass.,	Springfield.
84	Potato Phosphate,	Williams & Clark, Boston, Mass.,	Springfield.
89	Pelican Bone Standard Fertilizer,	H. J. Baker & Bro., New York, N. Y.,	Pittsfield.
104	Cleveland Superphosphate,	Cleveland Dryer Company, Cleveland, Ohio,	So. Framingham.
111	Great Planet A Manure, Potatoes, Onions, etc.,	Clark's Cove Company, Boston, Mass.,	Dighton.
114	Mapes' Manure for Potatoes,	Mapes Formula and Peruvian Guano Company, New York, N. Y.,	Fall River.
127	Ground Bone Fertilizer,	John C. Dow & Co., Boston, Mass.,	Amherst.
132	New Rival Ammoniated Superphosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Amherst.
154	Fish and Potash,	John S Reese & Co., Baltimore, Md.,	Greenfield.
181	High-grade Fish and Potash,	E. Frank Coe, New York, N. Y.,	Hadley.
189	The H. L. Phelps Fish and Potash,	Springfield Fertilizer Company, Springfield, Mass.,	Springfield.
190	The H. L. Phelps Complete Manure for Potatoes and Vegetables,	Springfield Fertilizer Company, Springfield, Mass.,	Springfield.
192	Adams Market Bone Phosphate,	Adams & Thomas, Springfield, Mass.,	Springfield.
200	Tobacco Grower,	L. B. Darling Fertilizer Company, Pawtucket, R. I.,	Amherst.
202	Dissolved Bone,	L. B. Darling Fertilizer Company, Pawtucket, R, I.,	Amherst.
203	Potato Special,	J. S. Reese & Co., Baltimore, Md.,	Springfield.
	Bones.		
126	Ground Bone,	John C. Dow & Co., Boston, Mass.,	Amherst.
131	Ground Bone Meal,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Amherst.
158	Ground Bone Meal,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Fitchburg.
168	Meat and Bone,	Thomas Hersom & Co., New Bedford, Mass.,	New Bedford.
171	Pure Ground Bone,	William Lavery, Amesbury, Mass.,	Amesbury.
174	Ground Bone,	J. E. McGovern, Lawrence, Mass.,	West Andover.

4. Analyses of Licensed Fertilizers, etc. — *Continued.*

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
1 89	Pelican Bone Standard Fertilizer,	16.60	2.04	1.85—2.27	6.02	3.20	1.02	10.24	-	9.22	8—10	2.94	2.25—3
5	Potato Manure,	9.70	3.98	3.30	3.68	2.13	.92	6.73	-	5.81	5.75	9.97	10
10 84	Potato Phosphate,	15.55	2.92	2.47—3.30	5.65	1.08	2.05	8.78	7—11	6.73	6—9	5.99	5—6*
15 114	Mapes' Manure for Potatoes,	11.62	3.46	3.71—4.12	7.04	1.26	.52	8.82	8—10	8.30	8	8.16	6—8*
27	Pure Dry Fish,	9.25	8.66	8.24—9.89	.64	3.25	4.91	8.80	6.87-11.45	3.89	-	-	-
30	Bradley's Complete Manure for Grass,	7.75	4.80	4.95—5.78	1.40	3.58	1.80	6.78	6—8	4.98	5—7	2.88	2.6—3.5*
39	Fish and Potash,	15.85	2.84	2.48—3.50	5.12	1.90	1.16	8.18	7.5—9.5	7.02	6—8	2.14	2—3*
44 80	Fish and Potash (Crossed Fish Brand),	15.06	3.46	3.30—4.12	3.86	1.65	2.51	8.02	5—8	5.51	3—5	3.49	3—5*
46	Corn Manure,	17.72	2.62	2.06—2.88	6.01	4.35	1.92	12.28	10—14	10.36	9—12	1.63	1.5—2.5*
47	Potato and Tobacco Manure,	14.63	2.66	2.06—2.88	5.67	1.74	2.62	10.03	9—13	8.41	8—11	3.26	3—4*
61	Dried Blood,	9.12	8.96	8.24—9.89	-	-	-	-	-	-	-	-	-
62	Dissolved Bone-black,	16.29	-	-	14.33	.96	.06	15.35	-	15.29	15—18	-	-
68	Dry Ground Fish Guano,	10.02	9.02	8—10	.64	3.71	3.20	7.55	-	4.35	4—6	-	-
79	Quinnipiac Phosphate,	11.55	2.44	2.47—3.30	5.17	5.70	3.29	14.07	10—14	10.87	9—12	2.31	2—3*
104	Cleveland Superphosphate,	12.23	2.52	2.05—2.85	4.81	4.45	2.00	11.26	11—14	9.26	9—11	2.44	2—3*
111	Great Planet A Manure, Potatoes, Onions, etc.,	12.27	3.40	3.30—4.12	6.02	.76	2.18	8.96	9—13	6.78	8—11.5	7.23	7—8*
127	Ground Bone Fertilizer,	8.25	2.00	2.06—2.47	.31	7.20	12.68	20.19	18—22	7.51	-	3.17	3—3.5
132	New Rival Ammoniated Superphosphate,	15.77	2.30	1.2—2	8.44	2.18	1.15	11.77	11—15	10.62	10—12	1.74	1.6—2.7*
154	Fish and Potash,	12.45	2.68	2.47—4.11	4.99	2.56	1.92	9.47	7—10	7.55	6.5—8	4.27	3—5
181	High-grade Fish and Potash,	16.01	3.34	3.3—4.1	2.60	2.91	2.51	8.02	7—11	5.51	6—9	2.68	2.75*
189	The H. L. Phelps Fish and Potash,	9.45	3.72	3.30—4.12	1.80	2.04	2.30	6.14	4—7	3.84	-	4.44	4—6
190	The H. L. Phelps Complete Man. for Pot. & Veg.,	8.12	3.32	4.12—4.94	3.22	2.25	1.18	6.65	6—8	5.47	5—6	7.69	8—10
192	Adams Market Bone Phosphate,	6.78	2.86	2.5—3.5	.47	5.47	10.00	15.94	8—10	5.94	6—8	4.96	3—5
200	Tobacco Grower,	8.27	4.44	4.94—5.77	2.68	2.94	2.18	7.80	10—12	5.62	-	11.34	10—12
202	Dissolved Bone,	14.10	2.32	1.65—2.47	9.08	6.27	1.66	17.01	21—23	14.97	14—16	-	-
203	Potato Special,	15.22	3.10	2.97—3.80	2.30	5.38	.64	8.32	-	7.68	6—8	8.04	7.5—9.5

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen Found.	Nitrogen Guaranteed.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Mechanical Analysis. Fine.	Mechanical Analysis. Fine Med.	Mechanical Analysis. Med.	Mechanical Analysis. Coarse Med.
	Bones.														
126	Ground Bone,	3.55	2.08	1.65—2.47	.13	7.04	18.93	26.10	24—26	7.17	-	54.36	45.42	.22	-
131 158	Ground Bone Meal,	6.75	1.98	2—3	-	10.44	19.18	29.62	25—28	10.44	-	85.95	10.13	3.92	-
168	Meat and Bone,	4.75	3.90	4.24	.26	6.39	13.69	20.34	19.52	6.65	6.73	52.74	33.14	11.70	2.42
171	Pure Ground Bone,	9.47	2.90	-	-	3.43	12.15	15.58	-	3.43	-	47.42	30.41	18.37	3.80
174	Ground Bone,	11.70	2.60	-	-	11.65	13.69	25.34	-	11.65	-	52.10	24.24	17.58	6.08

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* Sulphate of potash, the source of potash.

4. Analyses of Licensed Fertilizers, etc. — *Continued.*

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at —
	Compound Fertilizers.		
6	A. A. Ammoniated Superphosphate,	H. J. Baker & Bro., New York, N. Y.,	Northampton.
11	Fish and Potash,	Williams & Clark, Boston, Mass.,	Northampton.
14	Mapes' Grass and Grain, Spring Top Dressing,	Mapes Formula and Peruvian Guano Company, New York, N. Y.,	Northampton.
20	Chittenden's Complete Fertilizer for Potatoes, Roots and Vegetables,	National Fertilizer Company, Bridgeport, Conn.,	Northampton.
22	Stockbridge Special Potato Manure,	Bowker Fertilizer Company, Boston, Mass.,	Springfield.
25	A. A. Ammoniated Superphosphate,	H. J. Baker & Bro., New York, N. Y.,	Springfield.
29	Hill and Drill Phosphate,	Bowker Fertilizer Company, Boston, Mass.,	Worcester.
38	Bradley's Potato Manure,	Bradley Fertilizer Company, Boston, Mass.,	North Amherst.
53	Stockbridge Manure for Potatoes and Vegetables,	Bowker Fertilizer Company, Boston, Mass.,	Sunderland.
55	Hill and Drill Phosphate,	Bowker Fertilizer Company, Boston, Mass.,	Sunderland.
69	Williams & Clark's Corn Phosphate (Americus Brand),	Williams & Clark, Boston, Mass.,	Amherst.
70	Ammoniated Bone Phosphate, No. 1,	Leander Wilcox, Mystic, Conn.,	Amherst.
77	Ground Scrap,	Ellsworth, Tuthill & Co.,	Holyoke.
95	Chittenden's Complete Fertilizer for Potatoes, Roots and Vegetables,	National Fertilizer Company, Bridgeport, Conn.,	Pittsfield.
99	Tobacco Fertilizer,	Quinnipiac Fertilizer Company, Boston, Mass.,	South Deerfield.
135	Ammoniated Bone Superphosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Amherst.
137	Vegetable Bone Superphosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Amherst.
143	Manure for Light Soils,	Mapes Formula and Peruvian Guano Company, New York, N. Y.,	South Deerfield.
145	Gloucester Fish and Potash,	Bowker Fertilizer Company, Boston, Mass.,	Amherst.
149	Fine Wrapper Tobacco Grower,	Williams & Clark, Boston, Mass.,	Greenfield.
152	Complete Manure for Corn and Grain,	Bradley Fertilizer Company, Boston, Mass.,	Greenfield.
155	Samson Fertilizer,	Read Fertilizer Company, Syracuse, N. Y.,	Gardner.
159	Vegetable Bone Superphosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Fitchburg.
162	English Lawn Dressing,	Bradley Fertilizer Company, Boston, Mass.,	Lowell.
163	Farmer's New Method Fertilizer,	Bradley Fertilizer Company, Boston, Mass.,	Lowell.
165	Cumberland Potato Fertilizer,	Cumberland Bone Phosphate Company, Portland, Me.,	Lowell.
182	Ground Fish,	E. Frank Coe, New York, N. Y.,	Hadley.
185	Chittenden's Complete Fertilizer for Potatoes, Roots and Vegetables,	National Fertilizer Company, Bridgeport, Conn.,	Hadley.
186	Farm and Garden Phosphate,	Bowker Fertilizer Company, Boston, Mass.,	Northampton.
187	Square Brand Fish and Potash,	Bowker Fertilizer Company, Boston, Mass.,	Northampton.
194	Havana and Seed-leaf Tobacco Fertilizer,	Quinnipiac Fertilizer Company, Boston, Mass.,	Northampton.
201	Extra Bone Phosphate,	L. B. Darling Fertilizer Company, Pawtucket, R. I.,	Amherst.

4. Analyses of Licensed Fertilizers, etc. — *Concluded.*

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
6 25	A. A. Ammoniated Superphosphate, . . .	6.42	3.08	2.47—3.30	7.93	3.12	-	11.05	11—15	11.05	10—12	3.66	2—3
11	Fish and Potash, ...	8.92	3.46	3.30—4.12	3.07	2.22	2.51	7.80	6—8	5.29	3—5	3.48	3—5*
14	Mapes' Grass and Grain Spring Top Dressing, .	11.27	5.00	4.12—5.77	5.88	1.93	1.15	8.96	7—9	7.81	5—7	6.68	5—7
20 95 185	Chittenden's Complete Fertilizer for Potatoes, Roots and Vegetables, ...	8.52	3.98	3.30—4.12	3.71	5.12	2.56	11.39	8—10	8.83	6—8	6.66	6—8
22	Stockbridge Special Potato Manure, . . .	11.15	3.70	3.25—4.25	4.81	3.74	2.66	11.21	8—10	8.55	7—8	6.68	5—6
29 55	Hill and Drill Phosphate, ...	14.10	2.72	2.50—3.25	5.88	5.12	1.92	12.92	12—14	11.00	8—10	1.95	2—3
38	Bradley's Potato Manure, ...	13.49	3.00	2.50—3.25	2.97	3.32	3.28	9.57	8—11	6.29	6—8	5.41	5—6*
53	Stockbridge Manure for Potatoes and Vegetables,	10.85	3.36	3.25—4.25	5.09	2.82	2.58	10.49	8—10	7.91	7—8	6.93	5—6
69	Williams & Clark's Corn Phosphate, . . .	14.47	2.48	2.06—2.88	6.52	2.95	1.92	11.39	10.50—14	9.47	9—12	2.13	1.50—2.50*
70	Ammoniated Bone Phosphate, No. 1, . . .	15.95	3.27	2.50—3.50	3.20	2.55	2.05	7.80	7—8	5.75	6—7	5.25	5—6
77	Ground Scrap, ...	9.45	9.21	8.24	.13	3.58	3.20	6.91	6	3.71	-	-	-
99	Tobacco Fertilizer, ...	7.00	6.53	5.77	1.66	3.07	1.92	6.65	9—13	4.73	5	10.83	10*
135	Ammoniated Bone Superphosphate, . . .	14.15	3.71	2.90—3.70	9.59	1.66	.90	12.15	11—14	11.25	10—12	1.93	1—2*
137 159	Vegetable Bone Superphosphate, . . .	13.65	5.24	5—6	5.38	1.28	1.02	7.68	7—9	6.66	6—7	8.48	6—8*
143	Manure for Light Soils, ...	9.97	4.90	4.94—6.59	4.96	2.54	2.17	9.67	8—10	7.50	6—8	6.77	6—8
145	Gloucester Fish and Potash, ...	11.26	.94	.82—1.65	8.98	1.21	4.96	15.15	9—11	10.19	6—9	3.71	1—2*
149	Fine Wrapper Tobacco Grower, ...	7.45	5.54	5.77—6.59	1.43	2.48	2.05	5.96	6—9	3.91	5—7	11.97	10—12*
152	Complete Manure for Corn and Grain, . .	12.82	3.12	2.89—3.91	6.27	3.06	1.54	10.87	9—12	9.33	8—10	4.02	3—4*
155	Samson Fertilizer, ...	15.45	2.42	2.47—3.30	6.66	1.79	.51	8.96	9—12	8.45	8—10	6.20	5—6*
162	English Lawn Dressing, ...	8.72	5.35	4.95—5.70	2.04	3.34	1.02	6.40	6—9	5.38	5—7	4.63	2.50—3.50*
163	Farmers' New Method Fertilizer, ...	14.07	1.30	.82—1.65	5.62	2.96	2.30	10.88	10—12	8.58	8—10	3.80	2.16—3.24*
165	Cumberland Potato Fertilizer, ...	13.05	2.52	2.06—2.88	7.42	2.82	1.15	11.39	11—13	10.24	9—11	4.80	3—4*
182	Ground Fish, ...	10.57	8.32	8.24—9.06	.51	3.20	3.33	7.04	-	3.71	-	-	-
186	Farm and Garden Phosphate, ...	13.42	1.93	2—3	5.01	3.63	1.59	10.23	10—12	8.64	8—10	2.73	2—3
187	Square Brand Fish and Potash, ...	3.85	1.92	2.25—3.25	5.04	1.64	5.68	12.36	8—10	6.68	-	4.83	4—6
194	Havana and Seed-leaf Tobacco Fertilizer, . .	7.17	5.98	5.77—6.59	4.86	.64	.77	6.27	6—9	5.50	5—7	11.87	10—12*
201	Extra Bone Phosphate, ...	14.75	2.76	2.47—3.30	4.73	2.94	4.61	12.28	10—12	7.67	7—9	4.46	3—5

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* Sulphate of potash, the source of potash.

5. Analyses of Commercial Fertilizers and Manurial Substances sent on for Examination.

Wood Ashes.

[I., sent on from Amherst, Mass.; II. and III., sent on from Lawrence, Mass.; IV., sent on from Hudson, Mass.; V., sent on from Clifton, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	13.18	16.12	8.71	18.00	15.94
Potassium oxide,	4.56	3.94	5.77	4.51	4.71
Calcium oxide,	34.06	30.38	36.95	33.25	31.65
Magnesium oxide,	2.88	2.64	2.90	1.84	2.59
Ferric and aluminic oxides,	1.32	1.32	0.07	1.42	1.62
Phosphoric acid,	1.66	1.52	1.38	1.18	1.43
Insoluble matter (before calcination),	13.60	17.52	13.15	12.99	13.38
Insoluble matter (after calcination),	11.16	13.10	11.88	10.84	10.62

Wood Ashes.

[I., sent on from South Framingham, Mass.; II. and III., sent on from Townsend, Mass.; IV., sent on from South Sudbury, Mass.; V., sent on from Rock Bottom, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	9.68	13.40	5.28	8.00	1.54
Potassium oxide,	5.48	4.36	5.75	5.41	5.14
Calcium oxide,	37.02	31.25	29.85	38.83	38.64
Magnesium oxide,	3.30	3.81	2.23	3.31	4.18
Ferric and aluminic oxides,	1.09	0.07	1.68	1.00	1.48
Phosphoric acid,	1.26	1.28	2.00	1.27	2.17
Insoluble matter (before calcination),	14.81	18.17	23.03	14.95	15.23
Insoluble matter (after calcination),	12.41	14.50	19.82	11.95	12.43

5. ANALYSES, ETC. — *Continued.*

Wood Ashes.

[I., sent on from Clifton, Mass.; II., sent on from Beverly, Mass.; III., sent on from Hadley, Mass.; IV., sent on from Amherst, Mass.; V., sent on from Marblehead, Mass.]

	PER CENT.				
	I.	II.	III.	IV.	V.
Moisture at 100° C., . .	17.44	6.63	15.09	6.68	1.38
Potassium oxide, . . .	5.06	4.12	4.35	5.85	4.81
Calcium oxide, . . .	31.32	42.84	32.87	35.70	28.44
Magnesium oxide, . . .	1.48	2.20	2.89	3.83	2.26
Ferric and aluminic oxides, .	0.51	0.45	1.45	0.82	1.66
Phosphoric acid, . . .	1.39	0.84	1.69	1.65	3.47
Insoluble matter (before calcination), ...	13.80	13.92	14.60	11.54	33.08
Insoluble matter (after calcination), ...	10.46	12.43	12.07	9.13	26.78

Wood Ashes.

[I., sent on from Tewksbury, Mass.; II. and III., sent on from Sunderland, Mass.; IV. and V., sent on from North Amherst, Mass.]

	PER CENT.				
	I.	II.	III.	IV.	V.
Moisture at 100° C., . .	13.90	17.54	3.50	7.46	14.15
Potassium oxide, . . .	6.58	3.15	2.72	7.91	6.95
Calcium oxide, . . .	33.81	29.66	21.23	38.58	31.88
Magnesium oxide, . . .	2.19	3.28	2.39	2.59	1.73
Ferric and aluminic oxides, .	1.10	2.62	2.14	0.65	1.25
Phosphoric acid, . . .	1.74	1.87	1.65	1.25	1.42
Insoluble matter (before calcination), ...	10.00	17.90	44.80	8.11	11.10
Insoluble matter (after calcination), ...	8.65	12.98	39.69	6.04	8.99

5. ANALYSES, ETC. — *Continued.*

Wood Ashes.

[I., sent on from Sunderland, Mass.; II., sent on from North Hatfield, Mass.; III., sent on from Chicopee, Mass.; IV., sent on from Concord, Mass.; V., sent on from Millington, Mass.]

	PER CENT.				
	I.	II.	III.	IV.	V.
Moisture at 100° C., . .	7.80	16.74	15.70	18.67	1.02
Potassium oxide, . . .	4.44	5.24	4.67	4.90	7.78
Calcium oxide, . . .	–*	33.41	–*	–*	–*
Magnesium oxide, . . .	–*	3.40	–*	–*	–*
Ferric and aluminic oxides, .	–*	0.91	–*	–*	–*
Phosphoric acid, . . .	1.79	1.54	1.77	1.68	2.84
Insoluble matter (before calcination), ...	11.98	10.97	7.72	12.18	13.50
Insoluble matter (after calcination), ...	9.54	8.65	7.27	9.83	12.55

Wood Ashes.

[I., sent on from Boston, Mass.; II. and III., sent on from Sunderland, Mass.; IV. and V., sent on from Concord, Mass.]

	PER CENT.				
	I.	II.	III.	IV.	V.
Moisture at 100° C., . .	9.78	3.94	17.82	11.81	16.20
Potassium oxide, . . .	8.13	4.96	4.04	5.77	5.02
Calcium oxide, . . .	36.77	–*	–*	–*	31.64
Magnesium oxide, . . .	3.24	*	–*	–*	3.03
Ferric and aluminic oxides, .	0.36	–*	–*	–*	0.74
Phosphoric acid, . . .	1.60	2.28	1.71	1.68	1.65
Insoluble matter (before calcination), ...	8.38	23.86	10.56	11.72	11.03
Insoluble matter (after calcination), ...	6.58	23.42	8.80	9.23	9.07

* Not determined.

5. Analyses, etc. — *Continued.*

Wood Ashes.

[I., sent on from Boston, Mass.; II., sent on from South Deerfield, Mass.; III., sent on from North Amherst, Mass.; IV., sent on from Concord, Mass.; V., sent on from Sunderland, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C., . .	10.41	7.05	19.63	10.49	12.60
Potassium oxide, . . .	8.05	6.47	4.10	6.02	5.19
Calcium oxide, . . .	36.10	40.54	33.67	32.42	31.53
Magnesium oxide, . . .	3.17	2.84	1.76	3.60	2.31
Ferric and aluminic oxides, .	0.59	0.75	1.06	0.65	1.11
Phosphoric acid, . . .	1.68	1.56	1.61	1.55	1.59
Insoluble matter (before calcination), ...	8.39	9.08	12.33	11.37	17.15
Insoluble matter (after calcination), ...	6.49	6.45	10.26	8.37	14.42

Wood Ashes.

[I., sent on from Boston, Mass.; II. and III., sent on from Sunderland, Mass.; IV., sent on from South Deerfield, Mass.; V., sent on from Sudbury, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C., . .	10.46	16.55	25.50	10.40	13.95
Potassium oxide, . . .	5.08	3.36	3.54	4.60	4.04
Calcium oxide, . . .	33.83	27.67	31.29	33.97	27.98
Magnesium oxide, . . .	3.19	1.84	2.14	2.93	4.43
Ferric and aluminic oxides, .	0.78	0.94	0.60	1.35	1.59
Phosphoric acid, . . .	1.46	1.54	1.41	1.29	1.51
Insoluble matter (before calcination), ...	15.76	15.78	14.91	15.03	18.45
Insoluble matter (after calcination), ...	11.77	13.03	10.29	10.88	12.96

5. ANALYSES, ETC. — *Continued.*

Wood Ashes.

[I., sent on from South Deerfield, Mass.; II., sent on from Sudbury, Mass.; III., sent on from Hingham, Mass.; IV., sent on from Andover, Mass ; V., sent on from Byfield, Mass.]

	PER CENT.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	1.80	18.25	4.95	38.93	20.12
Potassium oxide,	6.19	3.36	5.64	2.34	6.70
Calcium oxide,	40.00	30.49	33.17	24.15	33.03
Magnesium oxide,	3.21	2.52	–*	–*	–*
Ferric and aluminic oxides,	1.44	1.22	–*	–*	–*
Phosphoric acid,	2.24	1.30	1.28	0.74	1.21
Insoluble matter (before calcination),	11.63	16.97	26.04	5.37	5.30
Insoluble matter (after calcination),	8.72	14.29	22.98	4.40	4.25

* Not determined.

Wood Ashes.

[I., sent on from Methuen, Mass.; II., sent on from Amesbury, Mass.; III., sent on from Readville, Mass.; IV., sent on from Amherst, Mass.; V., sent on from Sudbury, Mass.]

	PER CENT.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	20.92	19.17	20.60	17.50	20.52
Potassium oxide,	3.28	3.56	4.82	4.08	3.80
Calcium oxide,	31.60	26.80	33.60	33.40	31.20
Magnesium oxide,	2.95	3.13	2.85	4.46	3.20
Ferric and aluminic oxides,	1.14	2.02	1.05	1.70	1.32
Phosphoric acid,	1.34	1.47	1.40	1.54	0.90
Insoluble matter (before calcination),	17.04	21.55	13.62	16.28	11.36
Insoluble matter (after calcination),	14.43	18.46	12.21	13.44	9.14

5. ANALYSES, ETC. — *Continued.*

Wood Ashes.

[I., sent on from Waltham, Mass.; II., sent on from Hadley, Mass.; III. and IV., sent on from Boston, Mass.]

	PER CENT.			
	I.	II.	III.	IV.
Moisture at 100° C.,	12.58	14.39	9.04	18.90
Potassium oxide,	4.48	3.72	4.38	2.61
Calcium oxide,	33.12	34.12	27.94	37.90
Magnesium oxide,	–*	–*	–*	3.39
Ferric and aluminic oxides,	–*	–*	–*	1.47
Phosphoric acid,	1.34	1.36	1.16	1.16
Insoluble matter (before calcination),	18.68	12.02	27.29	8.92
Insoluble matter (after calcination),	17.55	9.34	23.45	7.15

Cotton-hull Ashes.

[I., sent on from Sunderland, Mass.; II. and III., sent on from Hatfield, Mass.]

	PER CENT.		
	I.	II.	III.
Moisture at 100° C.,	8.55	5.19	5.44
Potassium oxide,	26.68	32.28	12.03
Calcium oxide,	6.27	–*	6.24
Magnesium oxide,	8.48	–*	5.23
Ferric and aluminic oxides,	0.92	–*	4.93
Phosphoric acid,	8.55	7.42	6.12
Insoluble matter (before calcination),	18.93	27.15	45.82
Insoluble matter (after calcination),	15.65	–*	34.86

* Not determined.

5. ANALYSES, ETC. — *Continued.*

Cotton-hull Ashes.

[Three samples, sent on from Agawam, Mass.]

	PER CENT.		
	I.	II.	III.
Moisture at 100° C.,	7.71	4.20	4.58
Potassium oxide,	17.22	21.95	21.75
Calcium oxide,	5.93	9.46	9.66
Magnesium oxide,	8.13	11.50	10.95
Ferric and aluminic oxides,	–*	4.02	3.29
Phosphoric acid,	5.63	10.50	10.56
Insoluble matter (before calcination),	33.55	19.25	19.20
Insoluble matter (after calcination),	30.94	16.62	16.27

* Not determined.

Ivory Ashes.

[Sent on from Springfield, Mass.]

	Per Cent.
Moisture at 100° C.,	1.75
Potassium oxide,	2.44
Calcium oxide,	2.70
Magnesium oxide,	0.83
Ferric and aluminic oxides,	2.33
Total phosphoric acid,	2.05
Soluble phosphoric acid,	0.19
Insoluble matter (before calcination),	89.14
Insoluble matter (after calcination),	71.48

Lime-kiln Ashes.

[Sent on from Sunderland, Mass.]

	Per Cent.
Moisture at 100° C.,	0.00
Potassium oxide,	2.12
Calcium oxide,	56.28
Phosphoric acid,	1.21
Insoluble matter (before calcination),	15.11
Insoluble matter (after calcination),	12.63

5. ANALYSES, ETC. — *Continued.*

Corn-cob Ashes.

	Per Cent.
Moisture at 100° C.,	1.20
Potassium oxide,	7.08
Calcium oxide,	11.70
Magnesium oxide,	–*
Ferric and aluminic oxides,	1.28
Phosphoric acid,	2.37
Insoluble matter (before calcination),	59.14
Insoluble matter (after calcination),	52.09

Ashes.

[Sent on from Cambridge, Mass.]

	Per Cent.
Moisture at 100° C.,	4.98
Potassium oxide,	10.64
Phosphoric acid,	6.96
Insoluble matter (before calcination),	23.16
Insoluble matter (after calcination),	20.01

Wool Waste.

[Sent on from North Andover, Mass.]

	Per Cent.
Moisture at 100° C.,	4.47
Potassium oxide,	1.32
Nitrogen,	2.27
Insoluble matter,	39.30

Horn Shavings.

[Sent on from Leominster, Mass.]

	Per Cent.
Moisture at 100° C.,	4.83
Ash,	0.67
Phosphoric acid,	0.42
Nitrogen,	15.31
Insoluble matter,	Trace.

* Not determined.

5. ANALYSES, ETC. — *Continued.*

Tobacco Leaves.

[Sent on from Whately, Mass.]

	Per Cent.
Moisture at 100° C.,	13.05
Ash,	21.01
Potassium oxide,	7.24
Calcium oxide,	4.17
Magnesium oxide,	2.17
Ferric and aluminic oxides,	0.32
Phosphoric acid,	0.43
Nitrogen,	2.75
Insoluble matter,	4.17

I., Pine Needles; II., Pine Barren Grass.

[Sent on from Springfield, Mass.]

	PER CENT.	
	I.	II.
Moisture at 100° C.,	9.48	8.48
Ash,	3.42	2.40
Phosphoric acid,	0.12	0.18
Potassium oxide,	0.03	0.07
Nitrogen,	0.46	0.10
Insoluble matter,	1.22	1.07

Peat.

[Sent on from Weston, Mass.]

	Per Cent.
Moisture at 100° C.,	10.73
Ash,	17.26
Phosphoric acid,	0.03
Potassium oxide,	0.06
Nitrogen,	1.73
Insoluble matter,	10.14

Sludge.

[Sent on from Worcester, Mass.]

	Per Cent.
Moisture at 100° C.,	6.28
Ash,	70.05
Phosphoric acid,	1.36
Calcium oxide,	8.66
Ferric and aluminic oxides,	17.68
Nitrogen,	0.68
Insoluble matter,	38.03

5. ANALYSES, ETC. — *Continued.*

Muck.

[I , surface layer, one and one-half to four and one-half feet deep; II., under layer, four to six feet below surface, sent on from West Bridgewater, Mass.]

	PER CENT.	
	I.	II.
Moisture at 100° C.,	76.18	87.78
Ash,	8.24	1.23
Phosphoric acid,	0.08	0.02
Calcium oxide,	0.38	0.14
Nitrogen,	0.43	0.18
Insoluble matter,	6.45	0.63

Soot.

[Sent on from East Walpole, Mass.]

	Per Cent.
Moisture at 100° C.,	8.00
Ash,	88.98
Potassium oxide,	0.56
Calcium oxide,	3.50
Magnesium oxide,	0.83
Ferric and aluminic oxides,	2.01
Phosphoric acid,	0.83
Insoluble matter (before calcination),	82.52
Insoluble matter (after calcination),	80.72

Drainage from Manure Heaps.

[Sent on from Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	93.25
Ash,	3.66
Phosphoric acid,	0.24
Potassium oxide,	0.88
Total nitrogen,	0.98
Nitrogen as ammonia,	0.65

5. ANALYSES, ETC. — *Continued.*

Muriate of Potash.

[I., sent on from Amherst, Mass.; II. and III., sent on from South Hadley Falls, Mass.]

	PER CENT.		
	I.	II.	III.
Moisture at 100° C.,	0.54	1.07	0.85
Potassium oxide,	51.44	49.60	50.24
Insoluble matter,	Trace.	Trace.	Trace.

Sulphate of Potash.

[Sent on from Hatfield, Mass.]

	Per Cent.
Moisture at 100° C.,	2.22
Potassium oxide,	47.00
Insoluble matter,	Trace.

Gypsum (Land Plaster).

[Sent on from Millington, Mass.]

	Per Cent.
Moisture at 100° C.,	14.01
Calcium oxide,	33.45
Sulphuric acid,	46.86
Carbonic acid,	Trace.
Insoluble matter,	0.63

Gypse (Calcium Carbonate).

[Sent on from Pittsfield, Mass.]

	Per Cent.
Moisture at 100° C.,	1.64
Calcium oxide,	50.87
Insoluble matter,	2.87

5. ANALYSES, ETC. — *Continued.*

Florida Phosphates.

[I., II. and III., sent on from Concord, Mass.; IV., sent on from Marlborough, Mass.; V., sent on from Townsend, Mass.; VI., from station barn.]

	PER CENT.					
	I.	II.	III.	IV.	V.	VI.
Moisture at 100° C., .	1.38	0.36	1.51	2.24	3.08	2.53
Ash, ...	94.99	96.20	91.93	86.63	–*	89.52
Phosphoric acid, .	36.80	36.26	33.88	17.71	17.24	21.72
Calcium oxide, . .	46.21	51.78	45.53	14.64	25.62	17.89
Ferric and aluminic oxides, . . .	8.38	5.62	9.80	6.72	11.00	14.25
Carbonic acid, . .	–*	–*	–*	–*	4.45	1.83
Insoluble matter, .	1.42	2.20	1.47	13.37	29.22	30.50

Virginia Phosphatic Marls.

[I. and II., sent on from Arlington, Mass.; III., IV. and V., sent on from Enfield, Mass.]

	PER CENT.				
	I.	II.	III.	IV.	V.
Moisture at 100° C., . .	1.30	1.10	1.25	1.97	3.30
Ash, ...	94.85	90.94	–*	–*	–*
Total phosphoric acid, . .	9.06	5.99	9.37	13.73	10.39
Soluble phosphoric acid, .	0.26	0.08	0.00	0.00	0.00
Reverted phosphoric acid, .	0.15	0.22	0.00	0.00	0.41
Insoluble phosphoric acid, .	8.65	5.69	9.37	13.73	9.98
Potassium oxide, . . .	–	–	1.14	0.24	Trace.
Calcium oxide, ...	20.47	19.74	25.78	19.16	–*
Ferric and aluminic oxides, .	5.76	6.60	5.13	6.00	–*
Nitrogen, ...	–	–	–	–	1.61†
Insoluble matter, . . .	59.56	54.95	41.32	50.55	–

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* Not determined. † Addition, from an outside source.

5. ANALYSES, ETC. — *Continued.*

Ground Bone.

[I., sent on from Northborough, Mass.; II. and III., sent on from Westborough, Mass.; IV., sent on from Townsend, Mass.]

Mechanical Analyses.

	PER CENT.			
	I.	II.	III.	IV.
Fine,	51.57	47.50	46.93	37.30
Fine medium,	36.59	23.96	24.76	20.01
Medium,	11.84	16.10	17.46	24.83
Coarse medium,	–	12.44	10.85	17.86

Chemical Analyses.

Moisture at 100° C.,	3.30	2.28	2.85	3.50
Ash,	57.56	62.86	65.61	72.43
Total phosphoric acid,	23.50	26.07	27.07	26.23
Soluble phosphoric acid,	0.26	0.31	0.26	0.14
Reverted phosphoric acid,	7.43	8.16	9.10	5.28
Insoluble phosphoric acid,	15.81	17.60	17.71	20.81
Nitrogen,	4.02	2.71	2.90	2.12
Insoluble matter,	1.14	Trace.	Trace.	0.30

Bone Dust.

[Sent on from Hatfield, Mass.]

	Per Cent.
Moisture at 100° C.,	9.70
Total phosphoric acid,	26.39
Soluble phosphoric acid,	0.15
Reverted phosphoric acid,	14.32
Insoluble phosphoric acid,	11.92
Nitrogen,	3.74
Insoluble matter,	Trace.

Ivory Dust.

[Sent on from Lincoln, Mass.]

	Per Cent.
Moisture at 100° C.,	11.50
Ash,	52.63
Total phosphoric acid,	24.56
Soluble phosphoric acid,	0.97
Reverted phosphoric acid,	17.97
Insoluble phosphoric acid,	5.62
Nitrogen,	6.64

5. ANALYSES, ETC. — *Continued.*

Blood, Meat and Bone.

[Sent on from Holyoke, Mass.]

	Per Cent.
Moisture at 100° C.,	19.94
Ash,	19.76
Total phosphoric acid,	7.16
Soluble phosphoric acid,	0.51
Reverted phosphoric acid,	3.78
Insoluble phosphoric acid,	2.87
Nitrogen,	7.44
Insoluble matter,	0.52

Fish.

[I., sent on from Marshfield, Mass.; II., sent on from Danvers, Mass.; III., sent on from Marblehead, Mass.]

	PER CENT.		
	I.	II.	III.
Moisture at 100° C.,	37.88	6.96	6.17
Ash,	33.68	19.69	33.75
Total phosphoric acid,	5.45	8.14	15.10
Soluble phosphoric acid,	Trace.	–*	–*
Reverted phosphoric acid,	1.09	–*	–*
Insoluble phosphoric acid,	4.36	–*	–*
Nitrogen,	5.13	8.70	7.16
Insoluble matter,	0.21	1.07	2.77

I., Rat Guano (Virginia); II. and III., Bat Guanos (Virginia).

[Sent on from Lake Weir, Fla.]

	PER CENT.		
	I.	II.	III.
Moisture at 100° C.,	10.32	12.15	19.18
Ash,	–*	–*	68.40
Phosphoric acid,	2.30	3.26	3.44
Potassium oxide,	6.85	1.77	–
Nitrogen,	3.32	9.74	–
Insoluble matter,	1.15	5.77	32.89

* Not determined.

5. Analyses, etc. — *Concluded.*

Cotton-seed Meal.

[Sent on from Sunderland, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	4.35	5.83
Ash,	3.35	6.77
Phosphoric acid,	3.51	3.33
Potassium oxide,	2.25	2.01
Nitrogen,	6.86	6.66
Insoluble matter,	0.09	0.28

Home-mixed Fertilizers.

[I., sent on from Littleton, Mass.; II., sent on from Eastham, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	10.05	8.80
Ash,	62.74	78.24
Total phosphoric acid,	7.04	5.97
Soluble phosphoric acid,	5.77	5.21
Reverted phosphoric acid,	1.14	0.45
Insoluble phosphoric acid,	0.13	0.31
Potassium oxide,	18.56	18.08
Nitrogen,	3.38	4.68
Insoluble matter,	3.51	1.05

Complete Fertilizer.

[I., sent on from Norfolk, Mass.; II., sent on from Greenfield, Mass.; III. and IV.,* sent on from Eastham, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	8.61	6.90	9.92	8.35
Ash,	60.23	–†	–†	–†
Total phosphoric acid	9.98	8.32	9.34	20.60
Soluble phosphoric acid,	5.99	2.56	0.51	0.64
Reverted phosphoric acid,	3.45	3.46	3.71	8.19
Insoluble phosphoric acid,	0.54	2.30	5.12	11.77
Potassium oxide,	0.91	10.23	0.98	–
Nitrogen,	1.80	3.84	7.36	4.35
Insoluble matter,	7.67	–†	–†	–†

* Not a complete fertilizer, lacks potash.

† Not determined.

6. MISCELLANEOUS ANALYSES.

Exudation from an Elm Tree.

[Sent on from Greenfield, Mass.]

	Per Cent.
Moisture at 100° C.,	10.92
Glucose,	10.56
Sucrose,	72.62
Matter insoluble in water,	1.45
Resinous matter soluble in alcohol,	0.15

I., Skin or Husk Covering of the Coffee-cherry; II., Parchment Covering of the Coffee-bean.

[Sent on from Cambridge, Mass.]

	PER CENT.	
	I.	II.
Moisture at 100° C.,	9.69	8.57
Ash,	7.78	4.27
Phosphoric acid,	0.43	0.13
Potassium oxide,	1.55	0.97
Nitrogen,	1.27	0.78
Insoluble matter,	2.87	1.72

Baking Powder.

[Sent on from Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	15.20
Sodium oxide,	12.56
Calcium oxide,	6.60
Aluminium oxide,	3.31
Total carbonic acid,	12.40
Available carbonic acid,	11.65
Phosphoric acid,	12.49
Sulphuric acid,	15.98
Nitrogen,	1.13
Starch,	18.30
Insoluble matter,	0.73

6. MISCELLANEOUS ANALYSES — *Concluded.*

Preservaline.

[Sent on from Brightwood, Mass.]

	PER CENT.	
	I.	II.
Moisture at 100° C.,	5.56	3.96
Sodium oxide,	32.16	26.81
Potassium oxide,	0.80	15.79
Calcium oxide,	Trace.	Trace.
Chlorine	21.79	23.09
Nitrogen,	0.26	4.90
Sulphuric acid,	1.04	1.43
Insoluble matter,	0.08	0.09

Cider.

[Sent on from North Amherst, Mass.]

	Per Cent.
Alcohol,	4.53
Acid calculated as acetic,	0.60
Solid residue,	1.79

Vinegar.

	Per Cent.
Specific gravity,	1.00939
Acetic acid,	6.18
Solid residue,	1.33

Damaged Oats.

[Sent on from Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	13.70
Dry matter,	86.30
	100.00

Analysis of Dry Matter.

Crude ash,	4.03
" cellulose,	12.44
" fat,	5.96
" protein,	12.59
Non-nitrogenous extract matter,	64.98
	100.00

II.

ANALYSES OF MILK SENT ON FOR EXAMINATION.

[Per Cent.]

Number of Sample.	Solids.	Fat.	Solids not Fat.	Locality.	Remarks.
1,	15.23	6.92	8.31	North Adams.	
2,	7.79	0.41	7.38	Amherst.	Buttermilk.
3,	8.09	0.48	7.61	"	"
4,	8.48	0.36	8.12	"	"
5,	8.62	0.82	7.80	"	"
6,	8.78	0.27	8.51	"	"
7,	8.01	0.51	7.50	"	"
8,	13.25	4.25	9.00	Northborough.	
9,	15.38	6.00	9.38	Worcester.	
10,	11.72	3.69	8.03	Lancaster.	
11,	10.00	1.84	8.16	"	
12,	12.64	3.83	8.81	"	
13,	11.35	2.86	8.49	"	
14,	11.75	3.19	8.56	"	
15,	11.76	4.09	7.67	"	
16,	12.59	3.71	8.88	"	
17,	10.36	2.90	7.46	"	
18,	13.80	3.99	8.81	"	
19,	12.30	3.40	8.90	"	
20,	11.00	3.19	7.81	"	
21,	11.49	3.18	8.31	"	
22,	11.21	2.38	8.83	Chicopee.	
23,	11.74	3.62	8.12	Warren.	
24,	12.03	3.90	8.13	"	
25,	13.40	4.39	9.01	"	
26,	11.15	2.90	8.25	"	
27,	12.69	4.08	8.61	"	
28,	12.56	4.01	8.55	"	
29,	12.82	4.40	8.42	West Brookfield.	
30,	12.58	3.79	8.79	"	
31,	14.72	5.52	9.20	New Braintree.	
32,	14.36	5.02	9.34	"	
33,	15.07	5.65	9.42	"	
34,	16.50	7.17	9.33	"	
35,	13.73	4.78	8.95	"	
36,	13.92	4.86	9.06	"	
37,	13.90	5.06	8.84	"	
38,	13.21	4.36	8.85	"	
39,	14.63	5.34	9.29	"	

ANALYSES OF MILK, ETC. — *Concluded.*

NUMBER OF SAMPLE.	Solids.	Fat.	Solids not Fat.	Locality.	Remarks.
40, . .	15.54	6.33	9.21	New Braintree.	
41, . .	12.83	4.17	8.66	"	
42, . .	13.31	4.61	8.70	"	
43, . .	12.28	3.25	9.03	Warren.	
44, . .	12.27	3.25	9.02	"	
45, . .	15.18	4.67	10.51	"	
46, . .	11.86	3.01	8.85	"	
47, . .	12.54	3.49	9.05	"	
48, . .	12.43	3.32	9.11	"	
49, . .	14.93	6.86	8.07	Furnace.	
50, . .	11.94	3.44	8.50	"	
51, . .	12.20	3.48	8.72	Old Furnace.	
52, . .	12.58	3.52	9.06	"	
53, . .	11.95	3.19	8.76	Furnace.	
54, . .	12.13	3.54	8.59	"	
55, . .	13.82	4.09	9.73	"	
56, . .	12.09	3.62	8.47	"	
57, . .	13.02	4.14	8.88	"	
58, . .	11.61	2.98	8.63	"	
59, . .	11.98	3.35	8.63	"	
60, . .	12.55	3.68	8.87	"	
61, . .	11.93	3.34	8.59	"	
62, . .	12.47	3.81	8.66	"	
63, . .	12.07	3.62	8.45	South Lancaster.	
64, . .	12.42	3.68	8.74	"	
65, . .	11.43	3.12	8.31	"	
66, . .	10.63	2.86	7.77	"	
67, . .	11.65	3.53	8.12	"	
68, . .	11.62	3.31	8.31	"	
69, . .	12.33	4.17	8.16	"	
70, . .	11.56	3.11	8.45	Chicopee.	
71, . .	11.51	3.76	7.75	"	
72, . .	11.86	3.76	8.10	"	
73, . .	13.35	4.71	8.64	North Amherst.	
74, . .	13.13	4.14	8.99	"	

ANALYSIS OF MILK SENT ON FOR EXAMINATION.

[Babcock Mode.]

NUMBER OF SAMPLE.	Fat (Per Cent.).	Locality.	NUMBER OF SAMPLE.	Fat (Per Cent.).	Locality.
1, . . .	6.30	Hadley.	21, . .	4.90	Amherst.
2, . . .	5.60	"	22, . .	3.70	"
3, . . .	5.25	"	23, . .	3.70	"
4, . . .	5.20	"	24, . .	3.80	"
5, . . .	4.25	"	25, . .	4.50	"
6, . . .	4.45	"	26, . .	3.30	"
7, . . .	5.40	"	27, . .	4.00	"
8, . . .	5.50	"	28, . .	4.10	"
9, . . .	5.50	"	29, . .	5.40	"
10, . . .	4.65	"	30, . .	3.30	"
11, . . .	4.40	"	31, . .	3.30	"
12, . . .	5.15	"	32, . .	3.60	"
13, . . .	5.80	"	33, . .	3.90	"
14, . . .	4.85	"	34, . .	3.40	"
15, . . .	5.60	"	35, . .	3.00	"
16, . . .	4.40	"	36, . .	3.00	"
17, . . .	5.25	"	37, . .	3.30	"
18, . . .	2.80	Amherst.	38, . .	2.90	"
19, . . .	3.00	"	39, . .	3.00	"
20, . . .	2.10	"			

III.

ANALYSES OF WATER SENT ON FOR EXAMINATION.*

[Parts per million.]

NUMBER.	Actual Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids at 100° C.	Solids at Red Heat.	Hardness (Clark's Degree).	Lead.	Locality.
1	.004	.100	4.00	116.00	40.00	0.48	None.	Amherst.
2	.990	.440	15.00	164.00	54.00	2.47	None.	Weston.
3	.080	.270	9.00	105.00	45.00	2.73	None.	Weston.
4	.260	.964	34.00	237.00	130.00	-	-	Grafton.
5	.010	.096	8.00	90.00	30.00	2.08	None.	North Amherst.
6	.006	.106	5.00	110.00	60.00	1.95	None.	Amherst.
7	.066	.248	33.00	236.00	86.00	2.21	-	Amherst.
8	.020	.340	66.00	294.00	84.00	4.43	None.	Medway.
9	.100	.298	13.00	172.00	60.00	-	-	Worcester.
10	.146	.352	70.00	434.00	112.00	8.86	None.	Cochituate.
11	.010	.170	2.00	72.00	22.00	0.95	None.	Amherst.
12	.024	.112	8.00	70.00	20.00	2 86	None.	Amherst.
13	.217	.248	85.00	640.00	381.00	11.05	None.	Weston.
14	.047	.107	20.00	84.00	22.00	1.43	None.	Billerica.
15	.051	.595	3.00	206.00	90.00	5.57	None.	Amherst.
16	.020	.088	4.00	50.00	26.00	0.00	None.	Weston.
17	.044	.069	8.00	130.00	82.00	1.69	None.	Weston.
18	.226	.362	12.00	192.00	62.00	1.27	-	Prescott.
19	.096	.256	30.00	248.00	108.00	5.29	-	North Hadley.
20	.108	.238	7.00	276.00	136.00	-	-	Amherst.
21	.052	.438	6.00	150.00	30.00	2.47	None.	Littleton.
22	.576	.444	7.00	140.00	48.00	2.99	None.	Littleton.
23	.030	.225	65.00	474.00	264.00	14.21	None.	Barre.
24	.249	.163	28.00	320.00	176.00	2.73	-	South Deerfield.
25	.394	.472	2.00	106.00	32.00	0.63	None.	South Amherst.
26	-	-	-	-	-	-	None.	Amherst.

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* Analysis of well water at the station is confined to chemical tests with reference to an excess of foreign matter from sinks, barns, etc.

Analyses of Water, etc. — *Continued.*

Number.	Actual Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids at 100° C.	Solids at Red Heat	Hardness (Clark's Degree).	Lead.	Locality.
27	.104	.128	24.00	128.00	64.00	2.99	None.	Concord.
28	.112	.180	64.00	440.00	168.00	6.00	None.	Concord.
29	.080	.128	22.00	232.00	96.00	2.73	None.	Concord.
30	.424	.612	44.00	496.00	216.00	5.14	None.	Concord.
31	.032	.068	9.00	114.00	80.00	3.12	None.	South Amherst.
32	.024	.096	5.00	44.00	17.00	--	-	Greenwich.
33	.078	.466	170.00	638.00	474.00	13.91	-	Orange.
34	.038	.114	10.00	60.00	28.00	1.68	None.	Weston.
35	.130	.164	44.00	154.00	50.00	0.76	None.	Montague.
36	.072	.228	6.00	124.00	52.00	2.21	-	Barre.
37	.070	.257	14.00	132.00	20.00	1.69	-	East Foxborough.
38	.016	.260	2.00	44.00	24.00	1.95	-	Shirley.
39	.008	.160	26.00	148.00	58.00	4.16	-	Shirley.
40	.020	.206	4.00	260.00	32.00	1.43	-	Shirley.
41	.012	.146	3.00	64.00	18.00	0.48	-	Shirley.
42	.061	.235	24.00	194.00	62.00	4.29	None.	Amherst.
43	.018	.128	5.00	90.00	48.00	1.11	None.	Barre.
44	.030	.077	9.00	122.00	46.00	0.92	None.	Boston.
45	.028	.248	20.00	210.00	60.00	3.25	-	Amherst.
46	.112	.370	5.00	50.00	6.00	0.00	None.	Concord.
47	.022	.344	4.00	54.00	10.00	0.16	None.	Concord.
48	.050	.260	4.00	52.00	10.00	1.27	None.	Concord.
49	.022	.254	5.00	54.00	10.00	0.00	None.	Concord.
50	.004	.090	3.00	30.00	10.00	1.95	None	Hadley.
51	.005	.212	8.00	-	-	-	-	Hadley.
52	.036	.056	5.00	162.00	104.00	3.38	None.	Littleton.
53	.040	.130	20.00	208.00	78.00	4.03	None.	Littleton.
54	.072	.108	13.00	102.00	42.00	1.69	None.	Littleton.
55	.032	.232	24.00	204.00	80.00	4.43	None.	Littleton.
56	.024	.324	16.00	170.00	56.00	3.25	None.	Amherst.
57	.058	.085	9.00	86.00	18.00	1.43	-	East Foxborough.
58	.208	.132	20.00	196.00	66.00	4.86	None.	Amherst.
59	.240	.186	13.00	168.00	54.00	2.08	None.	Leverett.
60	.116	.096	36.00	280.00	34.00	3.38	None.	Amherst.

ANALYSES OF WATER, ETC. — *Continued.*

NUMBER.	Actual Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids at 100° C.	Solids at Red Heat.	Hardness (Clark's Degree).	Lead.	Locality.
61	.172	.552	11.00	150.00	30.00	1.95	None.	South Amherst.
62	.076	.170	44.00	294.00	124.00	5.86	-	Amherst.
63	.072	.193	13.00	226.00	112.00	2.73	None.	Northampton.
64	.342	.612	46.00	-	-	-	-	Amesbury.
65	.012	.126	50.00	142.00	60.00	1.43	-	Amesbury.
66	.007	.060	9.00	190.00	140.00	6.14	-	Springfield.
67	.014	.162	18.00	190.00	64.00	2.60	-	South Amherst.
68	.027	.090	10.00	190.00	60.00	3.25	None.	Agawam.
69	.036	.088	15.00	168.00	78.00	1.56	-	Amherst.
70	.012	.042	3.00	72.00	28.00	0.63	-	North Amherst.
71	.022	.039	8.00	96.00	60.00	0.95	-	Amherst.
72	.016	.116	6.00	68.00	12.00	0.00	-	Westminster.
73	.000	.076	34.00	184.00	76.00	3.51	-	Concord.
74	.048	.088	14.00	140.00	52.00	2.21	-	Concord.
75	.012	.096	8.00	188.00	84.00	1.27	-	Concord.
76	.016	.080	46.00	336.00	124.00	4.16	-	Concord.
77	.040	.140	6.00	104.00	52.00	0.32	-	Concord.
78	.024	.112	8.00	-	-	3.90	-	Chesterfield.
79	.100	.216	30.00	328.00	72.00	6.86	-	South Deerfield.
80	.016	.060	14.00	176.00	96.00	2.21	-	Medway.
81	1.340	.140	10.00	344.00	116 00	5.14	-	Smithville.
82	.036	.444	5.00	116.00	44.00	2.21	-	Ludlow.
83	.116	.212	4.00	180.00	104.00	2.08	-	Ludlow.
84	.144	.236	5.00	204.00	70.00	1.95	-	Ludlow.
85	.000	.064	20.00	248.00	80.00	3.25	-	Amherst.
86	.012	.048	6.00	114.00	60.00	0.16	-	Amherst.
87	.048	.128	3.00	-	-	4.57	-	Amherst.
88	.012	.048	18.00	160.00	64.00	2.73	-	South Deerfield.
89	.156	.100	32.00	348.00	116.00	6.71	-	South Deerfield.
90	.008	.176	12.00	196.00	68.00	0.63	-	Amherst.
91	.016	.088	14.00	172.00	100.00	3.51	-	Weston.
92	.176	.120	42.00	360.00	176.00	1.95	None.	Plainville.
93	.104	.076	24.00	-	-	7.29	None.	North Hadley.
94	.016	.084	4.00	244.00	132.00	2.34	-	North Amherst.

ANALYSES OF WATER, ETC. — *Concluded.*

NUMBER.	Actual Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids at 100° C.	Solids at Red Heat.	Hardness (Clark's Degree).	Lead.	Locality.
95	.000	.148	6.00	160.00	44.00	0.32	None.	Bolton.
96	.108	.056	8.00	168.00	92.00	2.47	None.	Weston.
97	.000	.072	4.00	136.00	64.00	0.32	None.	Rockville.
98	2.032	.168	42.00	324.00	164.00	8.86	-	North Hadley.
99	.088	.128	8.00	304.00	156.00	6.29	-	Amherst.
100	.280	.264	16.00	268.00	164.00	1.82	-	South Sudbury.
101	.008	.116	36.00	-	-	3.51	-	Amherst.
102	.048	.112	8.00	124.00	48.00	1.69	-	South Deerfield.
103	.112	.120	8.00	200.00	88.00	2.47	-	Westford.
104	.040	.076	6.00	172.00	64.00	3.25	-	Weston.
105	.012	.068	8.00	142.00	46.00	2.34	-	Waltham.
106	1.468	.368	26.00	548.00	312.00	8.00	-	North Andover.
107	.160	.272	108.00	472.00	148.00	8.71	-	North Andover.
108	.100	.128	10.00	180.00	68.00	3.25	-	North Andover.
109	.040	.128	15.00	100.00	28.00	3.38	-	Templeton.

The analyses have been made according to Wancklyn's process, familiar to chemists, and are directed towards the indication of the presence of chlorine, free and albuminoid ammonia, and the poisonous metals, lead in particular. (For a more detailed description of this method, see "Water Analyses," by J. A. Wancklyn and E. T. Chapman.)

Mr. Wancklyn's interpretation of the results of his mode of investigation is as follows: —

1. Chlorine alone does not necessarily indicate the presence of filthy water.

2. Free and albuminoid ammonia in water, without chlorine, indicates a vegetable source of contamination.

3. More than five grains per gallon * of chlorine (=71.4 parts per million), accompanied by more than .08 parts per million of free ammonia and more than .10 parts per million of albuminoid ammonia, is a clear indication that the water

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* One gallon equals 70,000 grains.

is contaminated with sewage, decaying animal matter, urine, etc., and should be condemned.

4. Eight hundredth parts per million of free ammonia and one tenth part per million of albuminoid ammonia render a water very suspicious, even without much chlorine.

5. Albuminoid ammonia, over .15 parts per million, ought to absolutely condemn a water which contains it.

6. The total solids found in the water should not exceed forty grains per gallon (571.4 parts per million).

An examination of the previously stated analyses indicates that Nos. 2, 3, 4, 9, 10, 13, 18, 19, 20, 22, 24, 25, 27, 28, 29, 30, 35, 46, 58, 59, 60, 61, 64, 79, 81, 83, 84, 89, 92, 93, 96, 98, 99, 100, 103, 106, 107 and 108 ought to be condemned as unfit for family use; while Nos. 7, 8, 14, 15, 21, 23, 33, 36, 37, 42, 48, 53, 54, 62, 63, 82 and 109 must be considered suspicious. From this record it will be seen that over one-third of the entire number of well waters tried proved unfit for drinking. Heating waters to the boiling point not unfrequently removes immediate danger.

Parties sending on water for analysis should be very careful to use clean vessels, clean stoppers, etc. The samples should be sent on without delay after collecting. One gallon is desirable for the analysis.

IV. COMPILATION OF ANALYSES MADE AT AMHERST, MASS., OF AGRICULTURAL CHEMICALS AND REFUSE MATERIALS USED FOR FERTILIZING PURPOSES.

PREPARED BY C. S. CROCKER.

[As the basis of valuation changes from year to year, no valuation is stated.]

1868-1893.

This compilation does not include the analyses made of licensed fertilizers. They are to be found in the reports of the State Inspector of Fertilizers from 1873 to 1892, contained in the reports of the Secretary of the Massachusetts State Board of Agriculture for those years. C. A. G.

	Analyses.	Moisture.	Ash.	NITROGEN.			POTASH.			TOTAL PHOSPHORIC ACID.			Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Soda.	Lime.	Magnesia.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
				Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.											
I. Chemicals, Refuse, Salts, Ashes, etc.																							
Muriate of potash,	61	1.95	-	-	-	-	58.98	45.94	**51.37**	-	-	-	-	-	-	6.69	-	.55	-	-	-	48.80	.70
Sulphate of potash,	22	2.71	-	-	-	-	51.28	21.36	**33.65**	-	-	-	-	-	-	4.46	-	1.50	-	45.72	-	-	.75
Sulphate of potash and magnesia,	15	4.75	-	-	-	-	29.48	16.96	**23.50**	-	-	-	-	-	-	6.25	2.57	-	-	44.25	-	2.60	1.41
Kainite,	4	3.20	-	-	-	-	16.48	12.51	**13.54**	-	-	-	-	-	-	18.97	1.15	9.80	-	20.25	-	33.25	2.13
Carnallite,	1	-	-	-	-	-	-	-	**13.68**	-	-	-	-	-	-	7.66	-	13.19	-	.56	-	41.56	-
Krugite,	1	4.82	-	-	-	-	-	-	**8.42**	-	-	-	-	-	-	5.27	12.45	8.79	-	31.94	-	6.63	14.96
Sulphate of magnesia (Kieserite),	9	22.70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.82	17.30	-	36.10	-	-	5.73
Nitrate of potash,	2	1.93	-	14.58	11.60	**13.09**	45.62	44.76	**45.19**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrate of soda,	22	1.40	-	16.01	14.44	**15.70**	-	-	-	-	-	-	-	-	-	35.50	-	-	-	-	-	.50	.50
Sulphate of ammonia,	24	1.00	-	21.68	19.70	**20.50**	-	-	-	-	-	-	-	-	-	-	-	-	-	60.00	-	-	-
Saltpetre waste,	11	2.60	-	3.30	.52	**2.28**	30.94	1.55	**14.34**	-	-	-	-	-	-	36.50	.75	.19	-	1.85	-	48.30	-
Nitre salt-cake,	2	6.03	-	-	-	**2.29**	-	-	**.87**	-	-	-	-	-	-	29.56	-	-	-	47.77	-	-	3.92
Wood ashes,	231	12.36	-	-	-	-	10.80	2.32	**5.21**	5.58	.51	**1.70**	-	-	-	-	33.88	3.31	.96	-	-	-	13.98
Cotton-seed-hull ashes,	36	7.49	-	-	-	-	42.12	9.91	**22.41**	13.67	2.89	**8.43**	-	-	-	-	9.33	10.47	1.71	-	-	-	13.51
Ashes of spent tan-bark,	5	4.84	-	-	-	-	2.87	.60	**1.81**	2.77	.13	**1.36**	-	-	-	-	31.11	3.39	1.78	-	-	-	25.21
Corn-cob ashes,	1	1.20	-	-	-	-	-	-	**7.08**	-	-	**2.37**	-	-	-	-	11.70	-	1.28	-	-	-	52.09

Railroad tie ashes,	1	4.70	-	-	-	-	-	-	.92	-	-	.56	-	-	-	-	2.51	-	-	-	-	-	80.20
Peat ashes,	1	4.67	-	-	-	-	-	-	.46	-	-	.11	-	-	-	-	2.28	1.63	6.13	-	-	-	45.17
Logwood ashes,	1	1.50	-	-	-	-	-	-	.08	-	-	2.30	-	-	-	-	3.90	-	-	-	-	-	9.70
Hard-pine wood ashes,	1	.75	-	-	-	-	-	-	10.16	-	-	2.24	-	-	-	-	24.95	-	-	-	-	-	29.90
Mill ashes,	1	.53	-	-	-	-	-	-	1.60	-	-	.46	-	-	-	-	34.93	1.35	-	-	-	-	36.36
Ashes from blue works,	1	12.14	63.78	-	-	-	-	-	9.02	-	-	-	-	-	-	-	-	-	-	-	-	-	12.30
Sea-weed ashes,	1	1.47	-	-	-	-	-	-	.92	-	-	.30	-	-	-	8.76	6.06	4.37	-	2.98	-	6.60	63.65
Gypsum,	2	13.52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	32.09	-	-	47.41	-	-	.59
Gypse,	1	1.64	-	-	-	-	-	-	-	-	-	-	-	-	-	-	50.87	-	-	-	-	-	2.87
Nova Scotia plaster,	10	6.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33.85	.75	-	45.75	-	-	2.50
Onondaga plaster,	4	13.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30.00	4.66	-	32.50	8.20	-	9.83
Gas-house lime,	3	22.28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	43.66	8.30	-	20.73	-	-	6.05
Lime waste from sugar factory,	1	36.30	-	-	-	-	-	-	.22	-	-	2.25	-	-	-	-	27.51	-	-	-	-	-	.32
Lime kiln ashes,	8	15.45	-	-	-	-	2.12	.02	1.02	3.16	.36	1.18	-	-	-	-	46.23	2.60	-	-	17.75	-	8.79
Marls (Massachusetts),	7	13.70	-	-	-	-	-	-	.24	2.72	.06	1.05	-	-	-	-	40.50	.64	.69	-	28.57	-	3.44
Marls (Virginia),	2	15.98	-	-	-	-	.61	.37	.49	.09	.08	.09	-	-	-	-	7.25	.21	-	.66	7.25	-	64.23
Green sand marl (Virginia),	1	1.25	-	-	-	-	-	-	1.14	-	-	9.37	-	-	-	-	25.78	-	5.13	-	-	-	41.32
Olive earth (Virginia),	1	1.97	-	-	-	-	-	-	.24	-	-	13.73	-	-	-	-	19.16	-	6.00	-	-	-	50.55
Ammoniated marl,	1	3.31	-	-	-	1.61	-	-	-	-	-	10.39	-	.41	9.98	-	-	-	-	-	-	-	-
Marl (North Carolina),	1	1.50	-	-	-	-	-	-	.04	-	-	.56	-	-	-	-	21.95	.61	-	-	-	-	50.18

	Analyses.	Moisture.	Ash.	Nitrogen.			Potash.			Total Phosphoric Acid.			Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Soda.	Lime.	Magnesia.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
				Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.											
II. Guanos, Phosphates, etc.																							
Peruvian guano,	26	14.81	37.61	13.50	4.44	**7.85**	4.08	1.14	**2.61**	20.60	5.96	**15.26**	4.57	3.79	6.90	-	-	-	-	-	-	-	6.60
Bat guano from Texas,	9	40.09	18.24	10.51	2.58	**6.47**	-	-	**1.31**	6.53	1.00	**3.76**	-	-	-	-	-	-	-	-	-	-	2.00
Bat guano from Florida,	2	15.66	-	-	-	**9.74**	-	-	**1.77**	3.44	3.26	**3.35**	-	-	-	-	-	-	-	-	-	-	19.33
Rat guano from Florida,	1	10.32	-	-	3.32	-	-	-	**6.85**	-	-	**2.30**	-	-	-	-	-	-	-	-	-	-	1.15
Cuba guano,	5	24.27	-	2.74	.63	**1.67**	-	-	-	16.16	11.54	**13.35**	-	-	-	-	-	-	-	-	-	-	3.17
Caribbean guano (orchilla),	12	7.31	-	-	-	-	-	-	-	35.43	18.11	**26.77**	-	-	-	-	39.95	3.29	-	2.68	-	-	1.27
Mona Island guano,	1	13.32	-	-	-	**.76**	-	-	-	-	-	**21.88**	-	7.55	14.33	-	37.49	-	-	-	-	-	2.45
South Carolina rock phosphate,	5	1.50	-	-	-	-	-	-	-	30.51	25.81	**28.03**	.27	.07	27.69	-	41.87	3.03	4.80	-	-	-	9.04
Florida rock phosphate,	26	2.12	-	-	-	-	-	-	-	38.97	6.95	**26.90**	-	-	-	-	30.32	-	7.59	-	-	-	27.33
Soft Florida phosphate,	1	2.24	-	-	-	-	-	-	-	-	-	**17.71**	-	-	-	-	14.64	-	6.72	-	-	-	13.37
Navassa phosphate,	2	7.60	-	-	-	-	-	-	-	34.45	34.09	**34.27**	-	-	-	-	37.45	-	10.27	-	-	-	2.70
Brockville phosphate,	1	2.50	-	-	-	-	-	-	-	-	-	**35.21**	-	-	-	-	-	-	-	-	-	-	6.46
Phosphatic slag,	4	1.45	-	-	-	-	-	-	-	30.51	18.91	**23 49**	-	3.06	21.65	-	48.66	3.42	10.12	-	-	-	9.40
Dissolved bone-black,	2	7.50	47.50	-	-	-	-	-	-	17.54	15.35	**16.45**	15.60	.60	.19	-	-	-	-	-	-	-	1.50
Bone-black,	5	4.60	-	-	-	-	-	-	-	30.54	16.56	**28.28**	-	-	-	-	-	-	-	-	-	-	3.64
South American bone-ash,	1	7.00	-	-	-	-	-	-	-	-	-	**35.89**	-	-	-	-	44.89	-	-	-	-	-	4.50
Acid phosphate,	1	14.23	69.95	-	-	-	-	-	-	-	-	**14.64**	10.34	2 42	1.88	-	-	-	-	-	-	-	10.81

III. Refuse Substances.																							
Dried blood,	14	12.50	6.37	13.55	8.10	10.52	-	-	-	6.23	1.53	1.91	-	-	-	-	-	-	-	-	-	-	-
Ammonite	1	5.88	-	-	-	11.33	-	-	-	-	-	3.43	-	-	-	-	-	-	-	-	-	-	1.38
Oleomargarine refuse,	1	8.54	14.42	-	-	12.12	-	-	-	-	-	.88	-	-	-	-	-	-	-	-	-	-	.96
Felt refuse,	1	29.24	33.53	-	-	5.26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sponge refuse,	1	7.25	-	-	-	2.43	-	-	-	-	-	3.19	-	-	-	-	3.94	1.27	-	-	-	-	39.05
Horn shavings,	1	4.83	-	-	-	15.31	-	-	-	-	-	.42	-	-	-	-	-	-	-	-	-	-	-
Ivory dust,	1	11.50	52.63	-	-	6.64	-	-	-	-	-	24.56	.97	17.97	5.62	-	-	-	-	-	-	-	-
Horn and hoof waste,	3	10.17	7.63	15.49	11.84	13.25	-	-	-	2.30	1.36	1.83	-	-	-	-	-	-	-	-	-	-	.24
Raw wool,	1	6.95	7.54	-	-	12.88	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.63
Wool waste,	8	14.26	24.10	10.20	1.05	5.27	3.08	.06	1.21	.67	.05	.35	-	-	-	-	.11	.06	.80	-	-	-	8.20
Wool washings (water),	1	-	-	-	-	-	-	-	3.92	-	-	-	-	-	-	.49	.28	-	-	-	-	-	-
Wool washings (acid),	1	-	-	-	-	-	-	-	4.20	-	-	-	-	-	-	.40	.61	.20	-	-	-	-	-
Wool washings (alkaline),	1	92.03	3.28	-	-	.09	-	-	1.09	-	-	-	-	-	-	.92	.04	-	-	-	-	-	.22
Meat mass,	5	12.09	13.60	11.50	9.69	10.44	-	-	-	3.58	.56	2.07	-	-	-	-	-	-	-	-	-	-	.58
Bone soup,	1	82.92	7.07	-	-	1.14	-	-	-	-	-	1.26	-	-	-	-	-	-	-	-	-	-	-
Dried soup from meat and bone,	1	14.80	8.40	-	-	9.97	-	-	-	-	-	.53	-	-	-	-	-	-	-	-	-	-	.64
Dried soup from rendering cattle feet,	1	10.80	7.50	-	-	14.47	-	-	-	-	-	.46	-	-	-	-	-	-	-	-	-	-	.26
Dried soup from horse rendering,	1	92.14	-	-	-	1.12	-	-	-	-	-	.14	-	-	-	-	-	-	-	-	-	-	-
Soap-grease refuse,	2	29.25	51.39	4.20	2.21	3.21	-	-	-	15.37	11.04	13.21	-	-	-	-	-	-	-	-	-	-	1.29
Bones,	139	7.39	56.03	4.70	1.62	4.01	-	-	-	32.52	15.16	23.34	.39	7.92	15.28	-	-	-	-	-	-	-	1.09
Tankage,	17	12.93	29.77	8.07	4.16	6.69	-	-	-	18.86	7.39	11.00	.31	5.02	5.67	-	-	-	-	-	-	-	1.27
Fish with less than twenty per cent. water,	60	12.63	21.50	11.40	6.81	7.24	-	-	-	11.26	5.50	8.24	.55	2.60	5.10	-	-	-	-	-	-	-	2.01

	Analyses.	Moisture.	Ash.	Nitrogen.			Potash.			Total Phosphoric Acid.			Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Soda.	Lime.	Magnesia.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
				Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.											
III. Refuse Substances—Concluded.																							
Fish with between twenty and forty per cent water.	10	30.19	20.59	7.41	4.22	5.97	-	-	-	8.32	4.68	7 09	.74	2.69	3.64	-	-	-	-	-	-	-	1.68
Fish with more than forty per cent. water,	10	45.46	15.50	7.60	2.43	4.97	-	-	-	8.56	2.94	5.08	1.17	1.33	2.58	-	-	-	-	-	-	-	1.35
Whale meat, raw, ...	1	44.50	1.04	-	-	4.86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lobster shells, ...	1	7.27	-	-	-	4.50	-	-	-	-	-	3.52	-	-	-	-	22.24	1.30	-	-	-	-	.27
Castor-bean pomace, ...	4	9.98	5.70	5.72	5.33	5.56	1.70	.64	1.12	2.22	1.57	2.16	-	-	-	-	.87	.29	-	-	-	-	1.75
Cotton-seed meal, ...	18	5.74	5.78	7.26	4.02	6.64	2.09	.89	1.72	3.36	1.26	1.82	-	-	-	-	.39	.99	-	-	-	-	.40
Rotten brewers' grain, ...	1	78.77	-	-	-	.72	-	-	.04	-	-	.43	-	-	-	-	.26	.15	-	-	-	-	.59
Tobacco leaf, ...	1	13.05	21.01	-	-	2.75	-	-	7.24	-	-	.43	-	-	-	-	4.17	2.17	.32	-	-	-	4.17
Tobacco stems, ...	6	10.61	14.07	2.91	.90	2.29	8.82	3.76	6.44	2.09	.44	.60	-	-	-	.34	3.89	1.23	-	-	-	-	.82
Cotton waste, wet, ...	1	34.69	-	-	-	1.30	-	-	.80	-	-	1.54	-	-	-	-	2.45	1.13	-	-	-	-	41.33
Cotton waste, dry, ...	3	6.44	60.60	2.09	.96	1.50	1.62	.66	1.10	.84	.26	.52	-	-	-	-	-	-	-	-	-	-	45.00
Cotton dust, ...	1	34.46	50.93	-	-	.50	-	-	.19	-	-	.21	-	-	-	-	.90	.90	-	-	-	-	47.46
Glucose refuse, ...	1	8.10	-	-	-	2.62	-	-	.15	-	-	.29	-	-	-	-	.18	.02	-	-	-	-	.07
Waste from lactate factory, ...	1	34.11	-	-	-	.68	-	-	-	-	-	.67	-	-	-	-	22.59	-	-	-	-	-	6.92
Hop refuse, ...	1	8.98	-	-	-	.98	-	-	.11	-	-	.20	-	-	-	-	.27	.10	-	-	-	-	.63
Banana skins, ...	1	13.99	-	-	-	.24	-	-	5.46	-	-	1.80	-	-	-	-	-	-	-	-	-	-	-
Sumac waste, ...	1	63.06	6.80	-	-	1.19	-	-	3.25	-	-	-	-	-	-	-	1.14	3.25	-	-	-	-	2.25
Eel-grass, ...	2	35.39	15.60	.96	.70	.83	1.61	.21	.91	.41	.22	.32	-	-	-	1.63	2.13	.11	-	-	-	-	1.06

Pine barren grass,	1	8.48	2.40	-	-	.16	-	-	.07	-	-	.18	-	-	-	-	-	-	-	-	-	1.67
Pine needles,	1	9.48	3.42	-	-	.46	-	-	.03	-	-	.12	-	-	-	-	-	-	-	-	-	1.22
Rockweed, green,	1	68.50	23.70	-	-	.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rockweed, dry,	1	10.68	35.75	-	-	1.45	-	-	4.89	-	-	2.75	-	-	-	7.90	7.66	.21	-	-	-	-	10.40
Jute waste,	1	13.10	-	-	-	1.50	-	-	.08	-	-	.72	-	-	-	-	-	-	-	-	-	-	-
Starch waste from rubber factory,	1	10.01	.23	-	-	.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sludge from sewage precipitating tanks,	1	88.49	9.50	-	-	.05	-	-	.05	-	-	.10	-	-	-	-	1.58	.39	6.22	-	-	-	.93
Sludge,	1	6.28	-	-	-	.68	-	-	-	-	-	1.36	-	-	-	-	8.66	-	17.68	-	-	-	38.03
Blue-green algæ (*Lyngbia majuscula*), dry,	1	16.26	-	-	-	4.25	-	-	.79	-	-	.19	-	-	-	3.53	2.06	1.18	-	-	-	-	5.53
Mussel mud, wet,	1	60.01	27.29	-	-	.21	-	-	6.17	-	-	.10	-	-	-	.70	.93	.14	3.48	-	-	-	-
Mussel mud, dry,	1	2.24	72.02	-	-	.72	-	-	-	-	-	.35	-	-	-	-	23.39	-	8.26	-	-	-	37.60
Salt mud,	2	53.37	41.19	.40	.39	.40	.33	.32	.33	-	-	-	-	-	-	.94	.91	.37	4.13	-	-	-	34.88
Fresh-water mud,	1	40.37	-	-	-	1.37	-	-	.22	-	-	.26	-	-	-	-	1.27	.29	1.80	-	-	-	18.26
Muck,	14	57.50	13.75	2.54	.26	1.05	-	-	-	.17	.08	.13	-	-	-	-	-	-	-	-	-	-	11.35
Peat,	10	61.50	8.20	1.40	.41	.85	-	-	.18	-	-	.08	-	-	-	-	.52	.72	2.14	-	-	-	2.20
Peat,	1	10.73	17.26	-	-	1.73	-	-	.06	-	-	.03	-	-	-	-	-	-	-	-	-	-	10.14
Turf,	2	19.29	6.36	1.97	1.91	1.94	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Soot,	1	5.54	77.10	-	-	-	-	-	1.83	-	-	-	-	-	-	-	-	-	-	-	-	-	35.34
IV. Animal Excrement, etc.																							
Barn-yard manure,	34	69.49	-	.87	.21	.49	.85	.13	.45	.75	.10	.33	-	-	-	-	.30	.19	-	-	-	-	6.20
Drainage from a manure heap,	1	93.20	3.66	-	-	.98	-	-	.88	-	-	.24	-	-	-	-	-	-	-	-	-	-	-
Poudrette, dry,	1	5.25	35.45	-	-	3.58	-	-	.49	-	-	5.74	-	-	-	-	-	-	-	-	-	-	4.65
Hen manure, fresh,	2	52.35	24.75	1.20	.79	.99	.32	.18	.25	1.00	.47	.74	-	-	-	-	1.19	.89	-	1.24	-	-	23.50
Hen manure, dry,	1	8.35	-	-	-	2.13	-	-	9.94	-	-	2.02	-	-	-	-	2.22	.62	-	-	-	-	34.64

V. COMPILATION OF ANALYSES OF FODDER ARTICLES, FRUITS, SUGAR-PRODUCING PLANTS, DAIRY PRODUCTS, ETC.,

MADE AT

AMHERST, MASS.

1868-1893.

PREPARED BY C. S. CROCKER.

A. ANALYSES OF FODDER ARTICLES.

B. ANALYSES OF FODDER ARTICLES WITH REFERENCE TO FERTILIZING INGREDIENTS.

C. ANALYSES OF FRUIT.

D. ANALYSES OF SUGAR-PRODUCING PLANTS.

E. DAIRY PRODUCTS.

F. INSECTICIDES.

A. Analyses of Fodder Articles.

NAME.	Analyses.	DRY MATTER.			ONE HUNDRED PARTS OF DRY MATTER CONTAIN—													Nutritive Ratio (Average).
					PROTEIN.			FAT.			NITROGEN-FREE EXTRACT.			FIBRE.			Ash.	
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.		
I. Green Fodders.																		
Fodder corn,	25	30.53	10.33	19.36	17.19	7.62	10.24	6.10	1.42	2.44	63.13	42.02	55.51	31.53	19.26	25.90	5.91	1:9.93
Fodder corn ensilage,	32	37.43	13.12	21.97	12.58	5.98	8.48	6.49	1.82	3.92	65.69	42.99	54.79	38.92	17.67	27.49	5.37	1:10.48
Corn and soja bean ensilage,	1	-	-	28.97	-	-	15.27	-	-	5.35	-	-	40.50	-	-	37.84	11.04	1:5.32
Sorghum,	6	23.18	12.38	17.41	11.84	7.46	8.74	2.00	1.21	1.55	64.93	47.65	56.15	29.27	22.00	26.73	6.83	1:11.85
Common millet,	9	49.29	21.32	35.42	12.16	5.43	7.50	3.99	2.09	2.74	58.61	46.39	53.89	33.98	24.88	30.99	4.84	-
Japanese millet (white head),	3	26.24	20.95	24.76	10.98	7.26	8.72	2.64	1.94	2.33	50.87	46.71	49.60	38.90	30.12	34.47	4.88	-
Japanese millet (red head),	6	33.83	22.66	27.33	7.99	4.92	6.90	2.45	1.58	2.01	60.83	50.11	52.91	35.29	25.21	32.10	6.08	-
White kibi,	2	24.26	22.85	23.56	15.14	10.79	12.97	1.61	1.50	1.56	53.66	52.30	52.91	31.70	23.03	27.37	5.19	-
Mochi millet,	3	42.29	30.07	37.42	11.90	6.11	9.94	1.94	1.74	1.81	67.08	49.06	55.69	29.80	20.01	25.56	7.00	-
Mix,	3	31.36	18.17	24.45	16.70	9.81	13.53	2.48	1.35	1.86	52.30	47.75	51.27	27.44	26.82	27.06	6.28	-
Green oats,	6	55.69	15.51	25.97	20.47	7.05	13.91	3.95	2.02	2.89	50.69	40.42	44.91	33.12	25.20	30.04	8.25	-
Green rye,	1	-	-	37.89	-	-	5.38	-	-	2.46	-	-	65.37	-	-	21.52	5.27	-
Green barley,	1	-	-	20.89	-	-	13.16	-	-	2.91	-	-	42.04	-	-	32.72	8.73	-
Timothy (*Phleum pratense* L.),	2	35.00	34.26	34.63	8.83	8.20	8.52	2.07	1.95	2.01	51.33	51.23	51.27	33.23	32.50	32.87	5.33	1:12.26
Hungarian grass (*Setaria Italica* Beauv.),	2	25.93	25.69	25.81	9.39	9.38	9.38	2.43	1.01	1.72	57.80	48.01	52.92	31.23	24.66	27.94	8.04	-
Vetch and oats (one part vetch and nine parts oats),	3	24.04	13.89	18.97	10.76	8.83	10.06	2.74	2.29	2.53	49.85	40.10	44.75	35.81	30.77	33.59	9.07	1:7.06

Vetch and oats (equal parts of each),	1	-	-	17.98	-	-	16.77	-	-	2.79	-	-	41.33	-	-	29.80	9.31	1:4.46
Barley and peas,	1	-	-	16.09	-	-	13.40	-	-	3.00	-	-	41.79	-	-	33.49	8.32	-
Oats and peas,	2	18.41	13.68	16.04	16.01	14.17	15.09	3.40	2.29	2.84	48.14	40.56	44.36	32.20	26.66	29.43	8.28	-
Horse bean, whole plant (*Vicia faba* L.),	1	-	-	15.17	-	-	16.68	-	-	2.31	-	-	47.09	-	-	28.17	5.75	1:2.71
Soja bean, whole plant (*Soja hispida* Mönch),	10	36.36	18.54	23.58	22.19	13.71	16.45	8.98	2.71	4.84	47.89	40.80	44.50	31.89	21.67	26.47	7.74	1:4.20
Cow-pea vines (*Dolichos sinensis* L.),	3	21.19	18.15	19.63	17.93	11.24	14.59	2.99	1.81	2.48	60.62	46.13	52.42	25.88	21.87	23.59	6.92	1:5.82
Serradella (*Ornithopus sativus* Brot.),	3	19.42	15.40	17.59	17.75	12.17	15.01	2.65	2.09	2.41	46.41	35.45	41.13	38.76	26.21	30.08	10.99	1:3.09
White lupine (*Lupinus albus* L.),	1	-	-	14.65	-	-	18.71	-	-	2.41	-	-	42.67	-	-	31.18	5.03	-
Spanish moss (*Tillandsia usneoides* L.),	1	-	-	39.20	-	-	4.45	-	-	2.54	-	-	57.73	-	-	32.61	2.67	-
II. Hay and Dry Coarse Fodders.																		
English hay (mixed hays),	11	91.94	86.96	89.85	11.93	8.47	9.67	3.18	1.56	2.38	54.72	44.95	49.59	35.55	29.21	32.15	6.21	1:9.55
Rowen of mixed hays,	13	91.16	75.55	82.38	14.70	11.63	12.64	5.03	2.60	3.60	53.52	41.92	49.89	31.50	24.25	26.63	7.24	1:6.76
Timothy hay,	6	92.76	81.26	89.39	9.37	7.24	8.66	2.65	1.95	2.22	54.43	50.01	51.55	36.59	29.21	32.90	4.88	1:11.94
Red-top hay (*Agrostis vulgaris* With.),	4	93.19	91.76	92.30	8.40	6.41	7.88	1.69	1.50	1.60	54.74	50.32	52.63	34.11	31.12	32.92	4.97	1:12.06
Kentucky blue-grass (*Poa pratensis* L.),	2	96.10	93.22	94.66	8.78	8.65	8.72	2.08	2.03	2.06	49.61	44.11	46.29	36.84	32.21	34.58	8.35	1:10.38
Orchard grass (*Dactylis glomerata* L.),	4	91.62	90.86	91.17	11.29	7.57	8.99	3.56	2.40	2.91	47.34	43.50	46.15	35.79	34.12	34.89	7.05	1:10.47
Meadow fescue (*Festuca pratensis* Huds.),	5	94.70	87.84	91.09	7.85	5.89	6.76	2.17	1.65	1.87	49.18	42.03	46.31	39.90	34.61	36.93	8.13	1:13.69
Perennial rye-grass (*Lolium perenne* L.),	4	93.64	90.50	92.60	16.56	6.59	11.71	3.15	1.59	2.37	55.77	38.82	48.14	30.86	26.79	29.64	8.14	1:7.40
Italian rye-grass (*Lolium Italicum* A. Br.),	4	92.62	90.70	91.54	9.75	6.20	8.15	2.07	1.39	1.85	52.80	43.09	49.14	36.90	31.27	33.34	7.52	1:10.90
Hungarian grass,	1	-	-	92.55	-	-	9.45	-	-	2.22	-	-	50.64	-	-	31.96	5.73	1:6.22
Barn-yard grass (*Panicum crus-galli* L.),	1	-	-	93.35	-	-	15.27	-	-	1.95	-	-	30.24	-	-	33.72	10.02	1:2.94
Hay of black-grass,	1	-	-	91.25	-	-	6.72	-	-	3.37	-	-	49.47	-	-	31.41	9.03	-

A. *Analyses of Fodder Articles* — Continued.

NAME.	Analyses.	DRY MATTER.			ONE HUNDRED PARTS OF DRY MATTER CONTAIN —													Nutritive Ratio (Average)
					PROTEIN.			FAT.			NITROGEN-FREE EXTRACT.			FIBRE.			Ash.	
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.		
II. Hay and Dry Coarse Fodders — Continued.																		
Low meadow hay,	1	-	-	91.99	-	-	9.51	-	-	1.88	-	-	46.27	-	-	35.59	6.75	-
Salt hay,	2	91.92	90.34	91.13	4.35	3.77	4.06	3.24	2.65	2.95	60.15	60.14	60.15	27.84	27.82	27.83	5.02	-
Millet,	6	93.85	90.25	92.54	8.88	7.09	7.81	3.63	.89	2.05	55.80	49.62	51.74	35.91	29.80	33.32	5.08	1:7.78
Oats in bloom,	1	-	-	93.57	-	-	6.58	-	-	2.92	-	-	50.03	-	-	34.06	6.41	1:14.23
Oats in milk,	1	-	-	90.45	-	-	10.89	-	-	2.69	-	-	46.02	-	-	34.32	6.08	1:7.90
Oats, ripe,	1	-	-	91.30	-	-	6.05	-	-	2.61	-	-	48.92	-	-	36.31	6.11	1:15.03
Winter rye in bloom,	1	-	-	91.45	-	-	10.66	-	-	2.57	-	-	47.40	-	-	32.97	6.40	1:8.28
Barley in milk,	1	-	-	89.75	-	-	10.26	-	-	2.76	-	-	52.91	-	-	29.12	4.95	1:9.59
Japanese buckwheat,	1	-	-	94.29	-	-	10.80	-	-	2.22	-	-	38.60	-	-	36.02	12.36	-
Dry fodder corn,	4	93.35	90.58	92.11	9.31	6.17	7.74	2.76	1.11	1.84	58.89	53.86	55.97	33.75	23.03	29.31	5.14	1:10.98
Corn stover,	26	94.44	75.00	88.18	12.15	5.46	7.29	2.63	1.08	1.38	63.05	44.65	50.82	38.83	20.93	34.84	5.67	1:11.62
Teosinte (*Euchlæna luxurians* Dur. and Asch.),	1	-	-	93.94	-	-	9.71	-	-	1.28	-	-	53.18	-	-	28.88	6.95	-
Mammoth red clover (*Trifolium medium* L.),	3	92.66	82.47	88.59	18.50	14.06	15.75	2.25	1.86	2.13	48.98	46.51	44.77	33.72	20.16	27.51	9.84	1:5.10
Medium red clover (*Trifolium pratense* L.),	2	94.90	93.98	94.44	15.01	14.63	14.82	2.62	2.36	2.49	43.88	42.81	43.34	30.76	29.97	30.37	8.98	1:5.52
Alsike clover (*Trifolium hybridum* L.),	6	93.92	86.48	90.07	17.55	14.77	16.63	3.26	1.88	2.58	46.64	38.03	42.72	32.34	21.44	26.17	11.90	1:3.25
Lucerne (alfalfa) (*Medicago sativa* Desr.),	5	95.40	84.00	91.40	16.34	11.12	14.22	2.50	1.04	1.65	51.62	40.25	46.20	34.39	25.42	29.72	8.11	1:4.09

Sand lucerne (*Medicago media* Pers.),	1	-	-	91.20	-	-	16.26	-	-	2.59	-	-	50.31	-	-	21.27	9.57	1:3.50
Bokhara clover (*Melilotus alba* Desr.),	2	93.64	91.50	92.57	14.93	11.81	13.37	4.79	1.85	3.32	51.36	38.83	45.08	33.05	28.08	30.57	7.66	-
Blue melilot (*Melilotus cœrulea* Desr.),	1	-	-	91.78	-	-	13.81	-	-	1.67	-	-	43.22	-	-	27.17	14.87	-
Sainfoin (*Onobrychis sativa*),	1	-	-	87.83	-	-	17.70	-	-	4.49	-	-	42.27	-	-	26.95	8.54	-
Sulla (*Hedysarum coronarium*),	2	91.68	89.59	90.61	17.03	16.90	16.97	3.16	2.39	2.78	58.66	41.89	50.26	28.95	12.38	20.67	9.32	-
Hairy lotus (*Lotus villosus* Thulll),	2	89.32	87.64	88.48	16.12	13.49	14.81	3.00	2.69	2.85	57.82	50.80	54.29	24.48	15.07	19.78	8.27	-
Soja bean,	3	93.88	79.91	89.10	19.06	15.10	16.68	8.33	5.62	6.77	51.28	41.09	46.96	25.84	20.76	22.79	6.90	1:4.23
Cow-pea,	3	90.70	90.25	90.43	17.17	16.95	17.05	4.49	3.81	4.06	51.41	46.06	47.93	23.58	19.06	21.67	9.29	1:4.82
Small pea (*Lathyrus sativus*),	1	-	-	94.20	-	-	16.57	-	-	1.49	-	-	42.76	-	-	32.88	6.30	-
Serradella,	3	92.80	87.23	90.44	17.97	15.26	17.03	2.91	2.37	2.55	50.23	44.49	48.18	25.92	24.37	25.15	7.09	1:4.85
Hairy vetch (*Vicia villosa* Roth.),	1	-	-	92.56	-	-	19.58	-		1.22	-	-	38.95	-	-	31.88	8.37	-
Common vetch (*Vicia sativa* L.),	2	91.65	90.55	91.10	15.76	14.42	15.09	2.69	2.30	2.50	44.34	43.29	43.80	30.68	30.05	30.37	8.24	1:3.87
Scotch tares,	1	-	-	84.20	-	-	22.00	-	-	1.89	-	-	31.46	-	-	30.89	13.76	-
Vetch and oats,	2	94.22	87.47	90.85	7.72	7.70	7.71	3.37	2.53	2.95	49.95	49.00	49.47	36.22	31.73	33.98	5.89	1:11.49
Horse-bean straw,	1	-	-	90.85	-	-	9.69	-	-	1.51	-	-	37.77	-	-	41.44	9.59	1:8.55
Soja-bean straw,	2	92.37	87.00	89.68	5.39	5.34	5.36	3.49	1.80	2.64	43.72	43.65	43.70	43.85	36.80	40.32	7.98	-
White daisy (*Chrysanthemum leucanthemum* L.),	1	-	-	90.35	-	-	7.68	-	-	2.32	-	-	46.86	-	-	36.09	7.05	-
Dry carrot tops,	1	-	-	90.24	-	-	20.12	-	-	2.01	-	-	50.39	-	-	13.61	13.87	-
Wheat straw,	1	-	-	93.80	-	-	7.20	-	-	1.63	-	-	50.46	-	-	35.91	4.80	1:8.00
Barley straw,	1	-	-	88.56	-	-	9.24	-	-	3.38	-	-	48.23	-	-	33.85	5.30	1:26.21
Japanese millet (white head),	1	-	-	91.48	-	-	7.67	-	-	2.41	-	-	49.87	-	-	34.99	5.06	-
Japanese millet (red head),	1	-	-	91.13	-	-	5.76	-	-	1.70	-	-	49.66	-	-	39.52	3.36	-

A. *Analyses of Fodder Articles* — Continued.

NAME.	Analyses.	DRY MATTER.			ONE HUNDRED PARTS OF DRY MATTER CONTAIN —													Nutritive Ratio (Average).
					PROTEIN.			FAT.			NITROGEN-FREE EXTRACT.			FIBRE.			Ash.	
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.		
II. Hay and Dry Coarse Fodders — Concluded.																		
Straw (*Panicum crus-galli*),	1	-	-	87.35	-	-	6.10	-	-	2.44	-	-	50.20	-	-	35.90	5.36	-
Straw (*P. miliaceum*),	1	-	-	87.83	-	-	3.94	-	-	3.01	-	-	44.72	-	-	42.16	6.17	-
Straw (*P. Italicum*),	1	-	-	80.28	-	-	4.17	-	-	1.59	-	-	46.39	-	-	41.54	6.31	-
III. Roots, Bulbs, Tubers, etc.																		
Beets, red,	7	14.51	9.75	12.17	15.40	7.82	12.29	1.76	.59	.94	79.33	66.87	72.19	7.56	4.29	6.00	8.58	-
Beets, sugar,	12	19.53	9.87	14.60	17.44	7.32	11.18	.83	.58	.67	81.50	61.93	75.62	9.69	4.82	6.55	5.98	1:7.41
Mangolds,	3	13.08	11.73	12.25	12.84	7.83	10.37	1.01	.73	.88	73.38	70.32	71.75	9.54	7.08	7.94	9.06	-
Beets, yellow fodder,	4	15.01	9.40	11.46	13.96	9.29	11.69	2.02	.84	1.39	75.22	61.90	69.33	9.66	7.26	8.14	9.45	-
Ruta-bagas,	3	12.77	8.25	10.88	11.46	10.34	11.01	2.32	1.23	1.53	68.58	62.27	65.88	13.12	11.03	11.83	9.75	1:11.83
Turnips,	3	12.80	8.22	9.79	10.81	9.67	10.12	2.05	1.42	1.74	70.62	65.91	68.44	12.61	10.12	11.23	8.47	1:13.26
Carrots,	4	12.52	9.95	10.72	9.63	7.98	8.93	3.94	1.67	2.34	73.96	67.24	71.27	10.76	7.55	9.19	8.27	1:9.67
Parsnips,	1	-	-	19.66	-	-	6.88	-	-	3.37	-	-	74.65	-	-	-	7.67	-
Potatoes,	10	21.95	13.91	18.78	13.56	6.24	10.01	.83	.17	.48	87.56	78.80	81.50	3.55	1.91	2.75	5.26	1:12.25
Apples,	2	24.83	19.68	22.26	4.57	3.92	4.25	2.81	1.71	2.26	86.21	83.44	84.81	7.05	6.14	6.60	2.08	1:26.44

IV. Grains and Other Seeds.																		
Corn kernels,	29	91.98	65.50	89.43	15.02	8.49	12.18	9.43	4.25	5.42	83.98	71.06	78.49	3.38	1.03	2.12	1.69	1:8.16
Sweet corn kernels,	1	-	-	88.02	-	-	12.57	-	-	9.56	-	-	73.83	-	-	2.41	1.63	-
Corn and cob meal,	37	94.00	80.89	89.47	15.06	7.82	10.01	5.27	3.36	4.19	81.41	70.13	76.62	10.41	5.63	7.54	1.64	-
Wheat kernels,	1	-	-	89.42	-	-	13.35	-	-	1.79	-	-	80.20	-	-	2.42	2.18	1:6.42
Broom corn seed,	1	-	-	85.90	-	-	11.21	-	-	4.05	-	-	74.05	-	-	8.34	2.35	-
Soja beans,	3	94.15	80.73	85.83	35.98	32.58	33.97	21.89	18.42	20.19	34.88	32.87	33.98	7.57	5.15	6.02	5.84	1:2.61
Horse beans,	1	-	-	89.72	-	-	30.03	-	-	1.11	-	-	56.48	-	-	8.11	4.27	1:2.24
Red adzinki beans,	2	85.18	83.10	84.14	25.14	23.75	24.45	.88	.76	.82	66.48	65.41	65.95	4.68	4.50	4.59	4.19	-
Saddle beans,	1	-	-	87.62	-	-	15.12	-	-	16.58	-	-	57.34	-	-	4.75	6.21	-
Daidzu beans,	1	-	-	88.47	-	-	38.99	-	-	18.59	-	-	30.41	-	-	4.97	7.04	-
Millet seed,	3	87.32	86.11	86.65	14.60	11.76	13.24	4.94	3.53	4.32	73.19	66.94	70.56	10.23	6.48	8.88	3.00	-
Chestnuts,	1	-	-	55.14	-	-	13.32	-	-	14.46	-	-	67.05	-	-	2.45	2.72	-
V. Flour and Meal.																		
Corn meal,	29	89.95	82.96	86.39	16.08	9.73	11.07	5.08	3.10	4.49	83.24	73.20	80.59	3.60	1.20	2.15	1.58	-
Hominy meal,	4	-	-	90.00	4.15	3.00	3.57	.67	.38	.57	63.62	60.58	61.78	33.77	31.36	32.93	1.21	1:30.85
Ground barley,	4	89.09	82.59	86.44	14.93	10.42	12.46	2.38	1.69	2.10	78.25	74.47	76.83	7.37	4.10	5.84	2.77	-
Broom-corn meal,	1	-	-	86.46	-	-	11.14	-	-	4.13	-	-	74.30	-	-	8.00	2.43	-
Pea meal,	1	-	-	91.15	-	-	20.95	-	-	1.67	-	-	55.02	-	-	19.42	2.94	-
Bean meal,	1	-	-	88.02	-	-	12.57	-	-	9.56	-	-	73.83	-	-	2.41	1.63	-
Millet meal (*Panicum Italicum*),	1	-	-	89.38	-	-	35.12	-	-	17.35	-	-	38.95	-	-	3.86	4.72	-

A. *Analyses of Fodder Articles* — Concluded.

NAME.	Analyses.	DRY MATTER.			ONE HUNDRED PARTS OF DRY MATTER CONTAIN —													Nutritive Ratio (Average).
					PROTEIN.			FAT.			NITROGEN-FREE EXTRACT.			FIBRE.			Ash.	
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.		
VI. By-products and Refuse.																		
Linseed cake, old process,	7	92.52	88.50	**90.54**	39.97	30.98	**36.64**	9.87	6.24	**7.16**	44.72	37.76	**40.61**	9.69	8.04	**8.68**	6.91	1:1.66
Linseed cake, new process,	5	94.94	88.17	**92.05**	41.02	35.03	**39.18**	4.08	2.17	**3.12**	46.49	40.83	**41.87**	10.31	8.93	**9.38**	6.45	1:1.32
Cotton-seed meal, decorticated,	19	94.31	88.81	**91.69**	51.79	36.54	**44.21**	14.72	9.47	**12.26**	35.84	20.22	**28.04**	10.83	5.87	**7.94**	7.55	-
Wheat bran,	35	92.58	86.30	**89.51**	20.54	15.67	**17.78**	6.08	2.80	**5.00**	62.18	51.77	**59.32**	14.26	7.49	**10.89**	7.01	-
Wheat middlings,	6	90.75	87.57	**89.93**	19.21	15.13	**16.72**	6.46	3.19	**5.31**	74.30	58.03	**61.77**	11.21	1.40	**9.21**	6.99	1:4.21
Rye bran,	2	91.82	86.30	**89.06**	18.98	16.52	**17.75**	3.03	2.07	**2.55**	73.56	69.24	**71.70**	4.54	3.46	**4.00**	4.30	1:4.88
Rye middlings,	1	-	-	**87.46**	-	-	**13.15**	-	-	**5.61**	-	-	**73.52**	-	-	**3.70**	4.02	1:7.28
Buckwheat middlings,	1	-	-	**88.49**	-	-	**25.49**	-	-	**7.53**	-	-	**66.36**	-	-	**5.18**	5.44	-
Gluten meal,	26	93.50	68.32	**90.65**	39.28	25.75	**31.42**	12.05	3.92	**8.18**	66.26	48.26	**57.48**	6.39	.41	**2.14**	.78	-
Maize feed,	3	91.40	90.25	**90.95**	29.40	21.33	**25.47**	7.90	6.15	**6.96**	62.12	53.85	**58.27**	9.65	7.93	**8.53**	.77	-
Corn germ meal,	1	-	-	**90.65**	-	-	**28.26**	-	-	**11.82**	-	-	**42.49**	-	-	**9.18**	8.25	-
Corn germ feed,	1	-	-	**92.45**	-	-	**10.81**	-	-	**12.17**	-	-	**62.10**	-	-	**14.05**	.87	-
Corn screenings,	1	-	-	**88.98**	-	-	**8.29**	-	-	**4.48**	-	-	**81.57**	-	-	**3.27**	2.39	-
Oat feed,	1	-	-	**90.66**	-	-	**14.06**	-	-	**8.23**	-	-	**66.52**	-	-	**8.79**	4.40	-
Cocoanut meal,	1	-	-	**90.67**	-	-	**22.61**	-	-	**12.88**	-	-	**40.03**	-	-	**18.80**	5.68	-
Bakery refuse,	1	-	-	**86.66**	-	-	**9.23**	-	-	**6.36**	-	-	**72.34**	-	-	**.43**	11.64	-

Vinegar mash,	1	-	-	5.51	-	-	16.50	-	-	8.45	-	-	63.47	-	-	8.55	3.03	-
Refuse from starch works,	1	-	-	42.96	-	-	22.41	-	-	10.17	-	-	58.98	-	-	7.54	.90	-
Spent brewers' grain,	4	93.02	88.00	90.13	33.16	16.08	23.29	6.29	1.95	4.89	67.62	42.32	54.04	15.90	8.07	11.25	4.53	1:2.90
Malt sprouts,	1	-	-	84.63	-	-	27.17	-	-	3.85	-	-	47.92	-	-	14.75	6.31	-
Cocoa dust from cocoa manufactory,	1	-	-	92.90	-	-	15.47	-	-	25.85	-	-	45.99	-	-	5.86	6.83	-
Broom-corn waste,	1	-	-	91.30	-	-	6.78	-	-	1.00	-	-	48.09	-	-	39.25	4.88	-
Cotton hulls,	2	89.83	88.55	89.10	5.36	4.90	5.13	4.27	2.36	3.31	46.75	38.59	42.67	51.40	40.24	45.82	3.07	1:28.16
Apple pomace,	2	21.78	17.22	19.50	7.73	6.94	7.34	4.37	3.17	3.78	72.93	70.20	72.56	16.58	13.15	14.86	1.46	-
Apple pomace ensilage,	1	-	-	14.67	-	-	8.22	-	-	7.36	-	-	58.03	-	-	22.18	4.21	-
Sugar beet pulp from diffusion battery,	1	-	-	10.32	-	-	12.41	-	-	.95	-	-	61.86	-	-	23.74	1.04	-
Corn cobs,	6	94.05	90.00	92.35	4.15	1.46	2.91	.77	.38	.56	63.62	58.78	61.21	37.84	31.36	33.96	1.36	-
Palmetto root,	1	-	-	88.49	-	-	3.82	-	-	.53	-	-	69.95	-	-	21.26	4.44	-

B. *Analyses of Fodder Articles with Reference to Fertilizing Ingredients.*

NAME.	Analyses.	Moisture.	Nitrogen.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.	*Valuation per 2,000 Pounds.
I. Green Fodders.												
Fodder corn,	14	78.61	.407	4.84	.327	.048	.153	.091	.018	.148	.380	$1 65
Fodder corn ensilage,	2	77.95	.278	-	.368	.050	.100	.090	.020	.113	.040	1 29
Corn and soja bean ensilage,	1	71.03	.790	-	.444	-	-	-	-	.420	-	3 23
Sorghum,	7	82.19	.233	-	.229	.025	.076	.075	.012	.088	.136	1 00
White kibi,	2	76.45	.489	1.22	.200	.045	.232	.148	.019	.136	.652	1 79
Mochi millet,	3	62.58	.609	2.62	.407	.120	.201	.217	.021	.188	.708	2 50
Mix,	3	75.59	.499	1.54	.363	.060	.249	.245	.021	.237	.527	2 08
Green oats,	3	83.36	.489	1.31	.381	.217	.154	.134	.018	.130	.496	1 95
Green rye,	1	62.11	.326	-	.734	-	-	-	-	.150	-	1 80
Vetch and oats,	1	86.11	.236	1.72	.789	.031	.087	.030	.012	.094	.331	1 53
Horse bean,	1	74.71	.675	-	1.370	.090	1.370	.620	.200	.330	2.040	3 62
Soja bean,	1	73.20	.292	-	.531	-	-	-	-	.151	-	1 61
Cow-pea vines,	1	78.81	.274	1.47	.306	.063	.300	.099	.016	.098	.077	1 21
Serradella,	2	82.59	.411	1.82	.420	.097	.460	.067	.021	.140	.097	1 77
Hungarian grass,	1	74.31	.386	-	.549	-	-	-	-	.159	-	1 87

White lupine,	1	85.35	.440	-	1.730	.680	3.070	.730	.170	.350	.900	3 26
Spanish moss,	1	60.80	.279	1.04	.255	.263	.089	.122	.029	.030	.191	1 10
II. Hay and Dry Coarse Fodders.												
English hay,	9	11.99	1.409	6.34	1.550	.110	.344	.240	.021	.269	.980	$5 92
Rowen,	12	18.52	1.609	9.57	1.486	.140	.640	.280	.034	.432	1.840	5 64
Timothy hay,	3	11.26	1.240	4.93	1.460	.180	.620	.120	.006	.342	1.000	5 41
Red-top,	4	7.71	1.150	4.59	1.020	.438	.571	.134	.036	.360	1.736	4 76
Kentucky blue-grass,	2	5.34	1.320	-	1.694	.129	.398	-	.044	.431	2.863	5 95
Orchard grass,	4	8.84	1.310	6.42	1.879	.225	.456	.297	.033	.414	2.060	6 08
Meadow fescue,	6	8.89	.992	8.08	2.096	.301	.576	.187	.028	.399	1.537	5 30
Perennial rye-grass,	2	9.13	1.227	6.79	1.553	.307	.642	.337	.044	.559	2.262	5 69
Italian rye-grass,	4	8.71	1.189	-	1.273	.451	.857	.321	.071	.556	2.598	5 32
Salt hay,	1	5.36	1.180	-	.718	.017	.371	.335	.028	.248	-	4 46
Japanese millet (white head),	3	10.45	1.105	5.80	1.223	.012	.465	.377	.028	.403	1.033	4 86
Japanese buckwheat,	1	5.72	1.629	-	3.320	.349	3.418	.421	.148	.852	.378	8 81
Fodder corn,	7	7.85	1.763	4.91	.889	.175	.605	.500	.075	.542	1.270	6 69
Corn stover,	16	9.12	1.043	3.74	1.400	.112	.622	.384	.068	.293	1.885	4 71
Teosinte,	1	6.06	1.460	6.53	3.696	.109	1.597	.458	.021	.546	.315	8 31
Millet hay,	1	9.75	1.280	-	1.690	.020	.500	.460	.030	.490	1.360	5 90
Mammoth red clover,	3	11.41	2.231	8.72	1.223	.389	3.141	.613	.111	.546	.779	8 39

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* The valuation is based on the following prices per pound of the essential fertilizing ingredients: Nitrogen, 15 cents; potassium oxide, 4½ cents; phosphoric acid, 5½ cents.

B. *Analyses of Fodder Articles with Reference to Fertilizing Ingredients* — Continued.

NAME.	Analyses.	Moisture.	Nitrogen.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.	Valuation per 2,000 Pounds.
II. *Hay and Dry Coarse Fodders* — Concluded.												
Medium red clover,	2	7.91	2.184	8.36	2.286	.210	1.689	.402	.099	.447	.919	$9 10
Alsike clover,	6	9.94	2.342	11.11	2.227	.309	2.153	.537	.197	.668	1.776	9 77
Lucerne (alfalfa),	4	6.26	2.075	6.82	1.461	.814	2.211	.406	.078	.526	.513	8 12
Bokhara clover,	2	7.43	1.975	7.70	1.832	.114	1.784	.347	.023	.558	.057	8 19
Blue melilot,	1	8.22	1.919	13.65	2.796	.270	1.449	.260	.349	.544	4.008	8 87
Sainfoin,	1	12.17	2.630	7.55	2.020	.540	1.160	.430	.040	.760	.470	10 54
Sulla,	2	9.39	2.460	-	2.093	.223	2.497	.350	.114	.453	.614	9 76
Lotus villosus,	2	11.52	2.095	8.23	1.807	.499	2.220	.476	.112	.594	.976	8 56
Soja bean,	2	6.30	2.320	6.47	1.079	.148	2.760	1.178	.115	.667	.977	8 66
Cow-pea,	1	9.00	1.635	8.40	.913	.122	2.696	.688	.046	.527	.832	6 31
Small pea,	1	5.80	2.497	-	1.990	.469	1.373	.276	.138	.592	1.081	9 93
Serradella,	2	7.39	2.697	10.60	.652	.656	2.545	.461	.066	.777	.590	9 83
Scotch tares,	1	15.80	2.964	-	3.004	.238	1.698	.354	.460	.815	4.062	12 49
Vetch and oats,	3	9.91	1.299	9.58	1.349	.420	.663	.265	.098	.560	.521	5 72
Soja-bean straw,	1	13.00	.750	-	1.322	-	.436	.469	.035	.397	.218	3 88
White daisy,	1	9.65	.279	6.37	1.253	.161	1.302	.191	.032	.435	1.110	2 44

Dry carrot tops,	1	9.76	3.130	12.52	4.883	4.028	2.089	.667	.118	.612	.098	14 46
Barley straw,	1	11.44	1.310	5.30	2.086	.183	.572	.180	-	.303	2.380	6 14
III. Roots, Bulbs, Tubers, etc.												
Beets, red,	7	87.73	.243	1.13	.436	.091	.049	.033	.004	.091	.020	$1 22
Beets, sugar,	4	86.95	.223	1.04	.477	.081	.057	.040	.013	.101	.048	1 21
Beets, yellow fodder,	1	90.60	.192	.95	.462	.104	.045	.030	.005	.086	.015	1 09
Mangolds,	2	87.29	.188	1.22	.383	.125	.061	.039	.005	.093	.023	1 01
Ruta-bagas,	3	89.13	.190	1.06	.489	.070	.088	.030	.004	.123	.012	1 15
Turnips,	2	89.49	.178	1.01	.385	.078	.089	.027	.009	.104	.055	0 99
Carrots,	2	89.79	.147	9.22	.506	.062	.067	.023	.009	.093	.019	1 00
Parsnips,	1	80.34	.217	-	.617	.006	.088	.045	.005	.187	.019	1 41
Potatoes,	1	79.75	.207	.99	.294	.013	.007	.020	.002	.066	.006	0 96
Apples,	2	79.91	.130	.41	.190	.030	.030	.030	.003	.010	.003	0 57
IV. Grain and Other Seeds.												
Corn kernels,	13	10.88	1.822	1.53	.404	.034	.032	.206	.019	.699	.020	$6 60
Corn and cob meal,	29	8.96	1.409	-	.472	.059	.018	.176	.011	.571	.430	5 28
Soja beans,	2	18.33	5.303	4.99	1.991	.275	.419	.909	.216	1.869	.093	19 75
Red adzinki beans,	1	14.82	3.240	-	1.540	.035	.090	.210	.180	.940	.050	12 14
White adzinki beans,	1	16.90	3.330	-	1.480	.190	.130	.220	.021	.970	.130	12 39
Saddle beans,	1	12.38	2.120	-	2.130	.020	.250	.430	.032	1.520	.250	9 95
Daidzu beans,	1	11.53	5.520	-	1.960	.210	.220	.400	.050	1.480	.280	19 95

B. *Analyses of Fodder Articles with Reference to Fertilizing Ingredients* — Concluded.

NAME.	Analyses.	Moisture.	Nitrogen.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.	Valuation per 2,000 Pounds.
IV. Grain and Other Seeds — Concluded.												
Japanese millet,	2	13.68	1.730	-	.380	.030	.045	.225	.015	.685	-	$6 22
Common millet,	1	12.68	2.040	-	.360	.060	.040	.260	.030	.850	.143	7 38
Chestnuts,	1	44.86	1.175	2.72	.632	-	.060	.135	.010	.392	.069	4 53
V. Flour and Meal.												
Corn meal,	2	13.52	2.050	1.42	.435	.064	.034	.187	.015	.707	.005	$7 31
Hominy feed,	1	8.93	1.630	2.21	.490	-	.180	.280	-	.980	-	6 41
Ground barley,	1	13.43	1.550	2.06	.341	.169	.091	.173	.013	.660	.669	5 68
Wheat flour,	1	9.83	2.210	1.22	.540	-	.170	.050	-	.570	-	7 74
Pea meal,	1	8.85	3.080	2.68	.993	.618	.302	.302	.027	.820	.122	11 04
VI. By-products and Refuse.												
Linseed cake, old process,	4	8.02	5.390	6.57	1.214	.860	.664	.763	.060	1.780	.340	$19 22
Linseed cake, new process,	4	7.35	5.808	5.04	1.288	.823	.663	.655	.062	1.628	.345	20 37
Cotton-seed meal,	9	8.96	6.467	6.49	1.723	.291	.587	.589	.020	2.333	.457	23 52
Wheat bran,	5	11.39	2.879	6.44	1.625	.159	.168	.899	.019	2.845	.141	13 23
Wheat middlings,	1	9.18	2.630	2.30	.630	.110	.200	.210	-	.950	-	9 50

Rye middlings,	1	12.54	1.840	3.52	.810	.030	.090	.320	.020	1.260	.170	7 63
Gluten meal,	5	8.53	5.090	.65	.047	.018	.050	.035	.009	.420	-	15 77
Spent brewers' grain,	2	8.58	2.680	6.15	.853	.347	.296	.286	.159	1.045	1.770	9 96
Cocoa dust,	1	7.10	2.299	6.35	.630	-	.630	-	-	1.340	-	8 94
Broom corn waste (stalks),	1	10.37	.870	4.70	1.858	-	.242	.170	-	.460	1.000	4 79
Cotton hulls,	3	10.63	.750	2.61	1.080	-	.200	.260	-	.180	.060	3 42
Apple pomace,	2	80.50	.227	.271	.134	.026	.037	.028	.008	.018	.009	0 82
Corn cobs,	8	12.09	.504	.815	.598	.071	.025	.045	.009	.063	.190	2 12
Palmetto roots,	1	11.51	.540	3.93	1.380	.345	.045	.004	.017	.157	.410	3 03
Buckwheat hulls,	1	11.90	.490	-	.521	-	.247	.236	.020	.073	.066	2 02

C. Analyses of Fruits.

NAME.	Date.	Dry Matter.	Specific Gravity of Juice.	Temperature C. of Juice (Degrees).	Total Sugar in Juice.	Glucose in Juice.	Cane Sugar in Juice.	*Soda Sol. required to neutralize 100 parts Juice.
	1877.	Per ct.			Per ct.	Per ct.	Per ct.	C. C.
Apple (Baldwin), . . .	Sept. 1,	20.14	1.055	12—15	3.09	-	-	-
Apple (Baldwin), . . .	Oct. 9,	19.66	1.065	12—15	6.25	-	-	-
Apple (Baldwin), . . .	Nov. 27,	-	1.075	12—15	10.42	-	-	-
Rhode Island Greening, . .	Sept. 1,	20.27	1.055	12—15	3.16	-	-	-
Rhode Island Greening, . .	Oct. 9,	19.68	1.066	12—15	7.14	-	-	-
Rhode Island Greening,† . .	Nov. 27,	20.25	1.080	12—15	11.36	-	-	-
Pear (Bartlett), . . .	Aug. 31,	15.00	1.060	12—15	4.77	-	-	-
Pear (Bartlett), . . .	Sept. 7,	16.55	1.060	12—15	5.68	-	-	-
Pear (Bartlett), . . .	Sept. 20,	-	1.065	12—15	8.62	-	-	-
Pear (Bartlett),‡ . . .	Sept. 22,	-	1.060	12—15	8.93	-	-	-
Cranberries, ...	-	10.71	1.025	15	1.35	-	-	-§
Cranberries, ...	1878.	10.11	1.025	15	1.70	-	-	-‖
Early York Peach (ripe), .	-	-	1.045	25	-	1.92	6.09	45
Early York Peach (nearly ripe),	-	10.96¶	1.039	25	-	1.36	4.12	42.3
Crawford Peach (nearly ripe),	-	-	1.050	18	-	2.19	7.02	85.6
Crawford Peach (mellow), .	-	11.36¶	1.055	18	-	1.70	8.94	76
Crawford Peach (not mellow),	-	11.88¶	1.045	22	-	1.67	5.92	64

* One part Na_2CO_3 in 100 parts of water.

† Picked October 9.

‡ Picked September 7.

§ Free acid, 2.25 per cent.

‖ Free acid, 2.43 per cent.

¶ In pulp, kept ten days before testing.

C. Analyses of Fruits — Continued.

[Wild and cultivated grapes.]

NAME.	Date.	Specific Gravity.	Temperature C. (Degrees).	Dry Matter.	Glucose in Juice.	Sugar in Dry Matter.	*Soda Sol. required to neutralize 100 parts Juice.
	1876.			Per ct.	Per ct.	Per ct.	C.C.
Concord,	July 17,	1.0175	31	8.30	.645	7.77	–
Concord,	July 20,	1.0150	31	8.10	.625	7.72	216
Concord,	Aug. 2,	1.0200	25	9.94	.938	9.44	249
Concord,	Aug. 16,	1.0250	28	10.88	2.000	18.38	229
Concord,	Aug. 30,	1.0500	25	15.58	8.620	55.33	120
Concord,	Sept. 13,	1.0670	23	17.48	13.890	79.46	55
Concord,	Sept. 4,	1.0700	18	19.82	16.130	81.38	49.2
Wild Purple Grape,	July 19,	1.020	31	9.00	.714	7.93	204
Wild Purple Grape,	Aug. 4,	1.020	28	12.25	1.100	8.98	246
Wild Purple Grape,	Aug. 16,	1.025	28	12.48	2.000	16.03	233
Wild Purple Grape,	Aug. 30,	1.050	26	16.58	6.500	39.81	147.6
White Wild Grape,	Aug. 31,	1.050	26	16.48	9.260	56.18	98
Hartford Prolific,	Sept. 5,	1.060	22	17.39	13.89	79.87	88.8
Ives' seedling,	Sept. 6,	1.070	26	20.15	15.15	75.14	88.6
Iona,	Sept. 7,	1.080	21	24.56	15.15	61.68	144
Iona (mildewed),	Sept. 7,	1.045	26	15.41	6.25	40.56	204.4
Agawam,	Sept. 11,	1.075	20	20.79	17.24	82.92	94.8
Wilder,	Sept. 11,	1.064	20	16.53	13.67	82.69	56
Delaware,	Sept. 12,	1.080	24	23.47	17.86	76.09	74
Charter Oak,	Sept. 12,	1.080	24	15.98	8.77	54.94	168.3
Israella,	Sept. 16,	1.075	23	19.67	9.20	46.77	89.8
Bent's Seedling,	Sept. 20,	1.080	21	20.65	16.13	78.11	181.8
Adirondack,	Sept. 20,	1.065	21	15.11	13.17	87.16	68
Catawba,	Oct. 16,	1.080	13	23.45	17.39	74.16	82
	1877.						
Wilder,	Sept. 11,	1.065	23	16.41	15.15	92.32	60
Charter Oak,	Sept. 12,	1.055	23	16.22	9.80	60.42	96
Concord,	Sept. 13,	1.065	24	15.90	13.16	82.76	102
Concord,	Sept. 26,	1.075	24	19.34	15.43	79.78	70.8
Eumalan,	Sept. 24,	1.065	16	19.62	13.16	67.07	73
Wild White Grape,	Sept. 5,	1.050	22	15.57	7.20	46.24	140.8
Wild White Grape (shrivelled),	Sept. 20,	1.060	16	20.02	10.00	49.95	130
Wild Purple Grape (shrivelled),	Sept. 20,	1.045	16	16.69	8.22	49.25	104

* One part of pure Na_2 CO_3 in 100 parts water.

C. Analyses of Fruits — Continued.

[Effect of girdling on grapes.]

NAME AND CONDITION.	Date.	Specific Gravity.	Temperature C. (Degrees).	Dry Matter at 100° C.	Glucose in Juice.	Sugar in Dry Matter.	*Soda Sol. required to neutralize 100 parts Juice.
	1877.			Per ct.	Per ct.	Per ct.	C. C.
Hartford Prolific, not girdled,	Sept. 3,	1.045	19	12.85	8.77	68.25	111.4
Hartford Prolific, girdled,	Sept. 3,	1.065	19	17.18	12.50	72.76	100
Wilder, not girdled,	Sept. 3,	1.055	19	15.41	10.42	67.62	108.2
Wilder, girdled,	Sept. 3,	1.075	19	17.24	14.70	85.26	88.4
Delaware, not girdled,	Sept. 4,	1.065	19	15.75	11.76	74.66	101.2
Delaware, girdled,	Sept. 4,	1.075	19	19.14	15.15	79.16	94.4
Agawam, not girdled,	Sept. 4,	1.060	19	16.60	11.37	68.48	128.2
Agawam, girdled,	Sept. 4,	1.075	19	18.45	16.31	87.42	114.8
Iona, not girdled,	Sept. 6,	1.0625	22	16.60	13.51	68.31	131.4
Iona, girdled,	Sept. 6,	1.085	22	21.48	15.63	72.76	125.6
Concord, not girdled,	Sept. 6,	1.045	22	13.46	7.46	55.42	182.4
Concord, girdled,	Sept. 6,	1.070	22	17.53	13.88	79.18	102.8
Concord, not girdled,	Sept. 26,	1.065	22	17.63	13.70	78.27	86
Concord, girdled,	Sept. 26,	1.080	22	24.47	19.61	80.13	76.8
Concord, not girdled,	Oct. 5,	1.075	12	20.92	17.50	85.37	42
Concord, girdled,	Oct. 5,	1.085	12	–	17.86	–	54

	Date.	100 Parts of Grapes contained —			
		Ash.	Moisture.	Glucose.	Tartaric Acid.
	1889.				
Concord, not girdled,	Sept. 23,	–	84.69	6.24	.75
Concord, girdled,	Sept. 23,	.42	83.00	8.13	.85
Concord, not girdled,	Oct. 8,	.53	84.51	6.09	.48
Concord, girdled,	Oct. 8,	.37	82.69	8.50	.50
	1890.				
Concord, not girdled,	Sept. 25,	.47	86.49	7.36	1.15
Concord, girdled,	Sept. 25,	.48	84.93	9.29	1.17
Concord, not girdled,	Oct. 9,	.53	85.39	7.67	.71
Concord, not girdled,	Oct. 9,	.59	85.11	6.65	.51
Concord, girdled,	Oct. 9,	.54	85.15	9.12	.74

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* One part of pure $Na_2 CO_3$ in 100 parts water.

C. *Analyses of Fruits* — Continued.

[Effect of fertilization upon the organic constituents of wild grapes.]

NAME.	Date.	Dry Matter.	Specific Gravity.	Temperature C. (Degrees).	Per Cent. of Glucose.	Per Cent. of Acids.	Remarks.
	1877.						
Wild Purple Grape Berries, .	Sept. 20,	16.31	-	-	8.03	-	Unfertilized.
Wild Purple Grape Berries, .	"	19.55	-	-	13.51	-	Fertilized.
Wild Purple Grape Juice, .	"	-	1.045	16	8.22	9.840	Unfertilized.
Wild Purple Grape Juice, .	"	-	1.065	16	13.51	1.149	Fertilized.
Wild White Grape Berries, .	"	20.02	-	-	-	-	Unfertilized.
Wild White Grape Berries, .	"	21.65	-	-	-	-	Fertilized.
Wild White Grape Juice, .	"	-	1.060	16	10.00	1.846	Unfertilized.
Wild White Grape Juice, .	"	-	-	-	14.29	.923	Fertilized.

[Effect of fertilization upon the ash constituents of grapes.]

NAME.	Date.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.	Remarks.
	1876.								
Wild Purple Grapes,	Sept. 13,	50.93	.15	22.23	5.59	.79	17.40	2.93	Unfertilized.
Wild Purple Grapes,	Sept. 20,	62.65	.85	14.24	3.92	.53	13.18	4.63	Fertilized.
Concord Grapes, .	July 7,	41.73	5.04	25.03	7.80	.55	18.48	1.37	Unfertilized.
Concord Grapes, .	July 17,	47.34	1.13	24.21	-	.75	21.38	.43	Unfertilized.
Concord Grapes, .	Aug. 18,	51.14	3.19	16.20	6.38	.65	20.77	1.67	Unfertilized.
Concord Grapes, .	Sept. 13,	57.15	4.17	11.30	3.10	.40	12.47	11.82	Unfertilized.
	1878.								
Concord Grapes, .	Oct. 3,	64.65	1.42	9.13	3.63	.50	14.87	5.80	Fertilized.

C. Analyses of Fruits — Concluded.

[Ash analyses of fruits and garden crops.]

NAME.	Ash.	100 PARTS OF ASH CONTAINED —						
		Potash.	Soda.	Lime.	Magnesia.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.
Concord Grape (fruit),	–	51.14	3.19	16.20	6.38	.65	20.77	1.67
Unfermented juice,	–	50.85	.48	3.69	4.25	.10	6.43	.90
Fermented juice,	–	40.69	–	6.85	6.24	–	9.04	–
Skins and pulp,	–	7.70	.42	57.36	8.80	.08	24.40	1.32
Seeds,	3.08	6.71	–	–	3.03	–	17.20	.29
Stems of grapes,	4.69	20.91	–	20.20	8.45	–	17.75	2.09
Young branches,*	–	24.71	.94	40.53	10.66	1.08	17.16	4.92
Wood of vine,†	2.97	22.57	–	9.72	4.28	–	14.07	23.84
Concord Grapes, 1891,‡	.55	49.76	–	3.50	2.53	1.19	13.56	2.01
Clinton Grape (fruit),	–	58.45	3.51	13.34	7.37	.90	18.19	–
Baldwin Apple,	–	63.54	1.71	7.28	5.52	1.08	20.87	3.68
Strawberry (fruit),§	.52	49.24	3.23	13.47	8.12	1.74	18.50	5.66
Strawberry (fruit),‖	–	58.47	–	14.64	6.12	3.37	17.40	–
Strawberry vines,	3.34	10.62	13.35	36.63	3.83	6.91	14.48	14.17
Cranberry (fruit),	.18	47.96	6.58	18.58	6.78	–	14.27	–
Cranberry vines,	2.45	12.98	3.27	16.49	10.33	3.35	10.94	34.04
Currants, red,	.47	47.68	4.02	18.96	6.23	1.20	21.91	–
Currants, white,	.59	52.79	3.00	17.08	5.68	2.67	18.78	–
Crawford Peach, sound,	–	74.46	–	2.64	6.29	.58	16.02	–
Crawford Peach, diseased,¶	–	71.30	–	4.68	5.49	.46	18.07	–
Branch, sound,	–	26.01	–	54.52	7.58	.52	11.37	–
Branch, diseased,¶	–	15.67	–	64.23	10.28	1.45	8.37	–
Carnation Pinks (whole plant),**	8.80	38.07	12.84	18.64	3.98	.34	5.23	.24
Asparagus stems,	–	42.94	3.58	27.18	12.77	1.22	12.31	.08
Asparagus roots,	–	56.43	5.42	15.48	7.57	–	15.09	3.67
Onions,	–	38.51	1.90	8.20	3.65	.58	15.80	3.33

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* With tendrils and blossoms.

† One year old.

‡ Nitrogen in dry matter, .96 per cent.

** Nitrogen in dry matter, 1.15 per cent.

§ Wilder.

‖ Downing.

¶ Yellows.

D. Analyses of Sugar-producing Plants.

[Composition of sugar beets raised upon the college grounds during the season of 1870 and 1871.]

NAME.	Date.	Brix Saccharometer (Degrees).	Per Cent. of Sugar.	Non-saccharine Substances.
Electoral, ...	Sept. 10,	14	12.30	1.75
Imperial, ...	" 12,	15	12.59	2.41
Vilmorin, ...	" 13,	14.5	12.95	1.55
Imperial, ...	" 18,	14	10.79	3.21
Imperial, ...	Oct. 11,	15	12.05	2.95
Electoral, ...	" 16,	15	12.22	2.78
Vilmorin, ...	" 18,	16	13.13	2.87
Imperial, ...	Nov. 14,	15	11.60	3.34
Vilmorin, ...	" 21,	15.5	13.12	2.38
Vienna Globe,*	Sept. 19,	11	8.00	3.00
Common Mangold,* . . .	" 19,	9	5.00	3.97

* Fodder beets.

[Percentage of sugar in different varieties of sugar beets grown on college farm during the season of 1882.]

NAME.	Source of Seed.	Weight in Pounds.	Per Cent. of Sugar in Juice.
I. Vilmorin, ...	Saxony, .	$\frac{3}{4}$ to $\frac{7}{8}$	15.50
II. Vilmorin, ...	Saxony, .	$\frac{3}{4}$ to 1	15.61
I. White Imperial, ...	Saxony, .	$\frac{3}{4}$ to $1\frac{3}{4}$	14.20
II. White Imperial, ...	Saxony, .	$1\frac{3}{4}$ to 2	10.27
New Imperial, ...	Saxony, .	$1\frac{1}{4}$ to $1\frac{3}{4}$	13.80
I. White Magdeburg, . . .	Saxony, .	$1\frac{1}{2}$ to 2	13.10
II. White Magdeburg, . . .	Silesia, .	$1\frac{1}{2}$ to $1\frac{3}{4}$	10.06
Quedlinburg, ...	Saxony, .	$1\frac{1}{2}$ to $1\frac{3}{4}$	13.44
White Silesian, ...	Silesia, .	$1\frac{1}{4}$ to $1\frac{1}{2}$	9.72

D. *Analyses of Sugar-producing Plants* — Continued.

[Effect of soil and fertilization on Electoral sugar beets.*]

SOIL.	MANURE.	Specific Gravity Brix (Degrees).	Per Cent. of Sugar in Juice.	Non-saccharine Substances.	Cane Sugar in Soluble Matter.
Sandy loam, .	Fresh yard-manure, .	16.5	12.50	4.00	75.08
Clayish loam, .	Fresh yard-manure, .	15.5	11.05	4.45	71.30
Warm alluvial, .	Yard-manure and chemicals, . . .	12.75	9.17	3.58	71.92
Warm alluvial, .	Fresh hog-manure, .	13.5	9.53	3.97	70.06
Light, sandy soil,	No manure, . . .	18.5	13.73	4.77	74.21
Alluvial soil, .	Brighton fish, . .	14.5	11.15	3.35	76.90
Heavy soil, .	Yard-manure, . .	12.25	8.15	4.10	66.53
–	–	13.5	9.90	3.60	73.33

* Not raised on college farm (Connecticut valley).

[Effect of fertilization on sugar beets.*]

FERTILIZERS.	PERCENTAGES OF SUGAR IN JUICE.		
	Freeport.	Electoral.	Vilmorin.
Fresh horse-manure, ...	11.96	9.42	7.80
Blood guano without potash, . .	10.99	10.10	10.20
Blood guano with potash, . . .	12.55	13.24	10.50
Kainite and superphosphate, . .	13.15	12.16	10.50
Sulphate of potash, ...	14.52	14.32	12.78
Second year after stable-manure, .	13.49	12.78	12.19

* All were grown on the same soil, — sandy loam (college).

D. Analyses of Sugar-producing Plants — Continued.

[Effect of different modes of cultivation on Electoral sugar beets.]

Locality of Beet-field.	Date.	Brix Saccharometer (Degrees).	Per Cent. of Cane Sugar.	Non-saccharine Substances.
1. Sing Sing, N. Y.,	1872–73	11	7.80	3.20
2. Washington, N. Y.,	"	14	10.97	3.03
3. South Hartford, N. Y.,	"	15	11.70	3.30
4. Greenwich, N. Y.,	"	12	9.50	2.50
5. Frankfort, N. Y.,	"	13.5	11.00	2.50
6. Albion, N. Y.,*	"	18	15.10	2.90
Albion, N. Y.,†	"	14	9.70	4.30

* From beets weighing from 1½ to 2 pounds. † From beets weighing from 10 to 14 pounds.

1. Soil, loam resting on clayish hard-pan, had been for several years in grass. Tomatoes had been the preceding crop. Five hundred pounds of a phosphatic blood guano were applied before planting.

2. Soil, a clayish loam, had been ploughed seven inches deep. A liberal amount of rotten sheep-manure was placed in trenches and covered by running two furrows together, thus forming a ridge on which the seed were planted.

3. Soil, a gravelly loam, which had been richly manured with stable compost and twice ploughed before planting.

4. Soil, a sandy loam, underlaid by fine sand. The seed were planted on ridges, which covered trenches containing a little rotten stable-manure.

5. No details of modes of cultivation received.

6. Soil, a dark, reddish-brown, rich, deep, sandy loam. Clover had been raised for two years previous to a crop of carrots, which preceded the sugar beets. The beets were the second crop after the application of twenty loads of stable-manure per acre.

Composition of Canada-grown Sugar Beets.

[1872 and 1873.]

Where Grown.	Weight of Roots.	Specific Gravity of Juice (Brix).	Temperature of Juice.	Per Cent. of Cane Sugar in Juice.
Echaullon de Montreal,	2 to 2½ lbs.	15.4°	64° F.	11.38
Riviere du Loup,	2 to 3¼ lbs.	14.5°	63° F.	10.20
Chambly,	2 to 2½ lbs.	13.2°	63° F.	9.02
Maskinonge,	2 to 3 lbs.	13.4°	63° F.	8.83

D. Analyses of Sugar-producing Plants — Continued.

[Early Amber Cane.]

DATE.	CONDITION OF CANE.	Brix Saccharometer (Degrees).	Temperature C. (Degrees).	Glucose.	Cane Sugar.	Soda solution required to neutralize 100 parts of Juice.	Solids.
1879.				Per ct.	Per ct.	C. C.	Per ct.
Aug. 15,	No flower stalks in sight, *	4.2	27	2.48	None.	6.8	7.93
Aug. 16,	No flower stalks in sight, *	5.8	24	4.06	None.	9.0	11.10
Aug. 20,	Flower stalks developed,*	7.9	24	3.47	2.15	7.0	13.00
Aug. 24,	Flowers open,*	8.7	23	3.70	3.00	4.0	14.07
Aug. 27,	Plants in full bloom,*	10.0	25	3.65	4.13	10.0	15.48
Aug. 30,	Seed forming,*	9.5	30	4.00	3.81	9.5	16.14
Sept. 2,	Seed in milk,*	10.7	27	3.85	4.41	9.5	15.85
Sept. 9,	Seeds still soft,*	12.1	22	3.21	6.86	9.5	26.13
Sept. 9,	Stripped on Sept. 2,*	12.8	22	3.77	6.81	9.5	26.75
Sept. 18,	Left on field without stripping,*	13.2	22	3.57	7.65	–	–
Sept. 18,	Tops removed,*	13.8	22	3.16	8.49	–	–
Sept. 18,	Tops and leaves removed on Sept. 9,*	11.5	22	3.16	5.85	–	–
Sept. 18,	Tops removed; left on field 9 days,*	12.8	22	10.00	.60	–	–
Sept. 21,	Juice from the above,*	13.0	21	–	–	–	–
Sept. 23,	Juice from the above,*	15.0	18	–	–	–	–
Sept. 25,	Left on field 3 weeks,†	19.8	21	11.91	6.27	–	–
Sept. 28,	Left on field 3 weeks,†	17.8	12	16.60	–	–	–
Oct. 4,	Left on field 3 weeks,†	16.1	17	8.62	6.16	12.0	–
Oct. 7,	Freshly cut. Ground with leaves,†	16.7	20	4.16	9.94	6.8	–
Oct. 8,	Freshly cut. Stripped two weeks,†	12.8	17	5.16	5.27	7.0	–
Oct. 9,	Freshly cut. Stripped two weeks,†	18.4	17	7.57	–	10.6	–
Oct. 14,	Several weeks old,†	18.2	15	10.42	–	10.4	–
Oct. 18,	Several weeks old,†	15.1	23	7.57	–	–	–
Oct. 19,	Several weeks old,†	15.5	15	9.22	–	13.6	–
Oct. 22,	Several weeks old,†	16.2	16	8.30	–	–	–
Oct. 23,	Several weeks old,†	18.3	17	11.30	5.5	14.0	–
Oct. 24,	Several weeks old,†	16.6	15	8.63	–	9.0	–

		100 PARTS OF CANE CONTAINED —				
		Moisture.	Glucose.	Cane Sugar.	Total Sugar.	
1889.						
October,	Early Tennessee sorghum, mature,	77.43	1.79	3.21	5.00	Grown on station grounds.
October,	Price's new hybrid, ripe,	77.80	2.92	3.78	6.70	
October,	Kansas orange, green,	80.67	2.38	3.63	6.01	
October,	New orange, green,	78.30	2.96	3.85	6.81	
October,	Honduras, green,	77.55	3.08	4.01	7.09	

* Raised on the college farm. † Raised by farmers in the vicinity of the college.

D. Analyses of Sugar-producing Plants — Concluded.

[Composition of the juice of corn stalks and melons.]

VARIETY.	Specific Gravity.	Temperature C. (Degrees).	Glucose.	Cane Sugar in Juice.	Solids.
			Per ct.	Per ct.	Per ct.
Northern corn,*	1.023	27	4.35	0.28	15.18
Black Mexican sweet corn,†	1.048	27	2.06	7.02	17.44
Evergreen sweet corn,†	1.052	–	4.85	5.70	20.38
Common sweet corn,‡	1.035	–	6.60	None.	–
Common yellow musk-melon,§	1.040	26	1.67	2.65	–
White-flesh water-melon,	1.025	18	2.91	2.16	–
Red-flesh water-melon,	1.025	22	3.57	2.18	–
Red-flesh water-melon,	1.025	19	3.84	1.77	–
Nutmeg musk-melon,‖	1.030	19	3.33	2.11	–
Nutmeg musk-melon,¶	1.050	20	2.27	5.38	–
Nutmeg musk-melon,**	1.030	19	2.50	1.43	–

* Tassels appearing.
† Ears ready for the table.
‡ Kernels somewhat hard.
§ Fully ripe.
‖ Not ripe.
¶ Ripe.
** Over-ripe.

E. Analyses of Dairy Products.

	Analyses.	SOLIDS.			FAT.			CURD.			SALT.			Ash.
		Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	
Whole milk,	1,401	18.27	10.58	13.44	7.54	2.48	4.06	-	-	3.20	-	-	-	.70
Skim milk,	303	10.40	7.68	9.49	1.02	.20	.40	-	-	3.53	-	-	-	.80
Buttermilk,	24	9.86	7.40	8.19	.38	.15	.27	-	-	2.79	-	-	-	.80
Cream (from Cooley Creamer),	121	29.35	21.30	25.35	20.90	13.74	17.40	-	-	-	-	-	-	.62
Butter,	25	92.89	87.05	89.11	89.05	81.43	83.95	.89	.51	.66	6.45	3.46	4.74	-
Whole-milk cheese (Jersey),*	1	-	-	62.84	-	-	37.32	-	-	22.13	-	-	-	3.39
Whole-milk cheese,*	1	-	-	64.17	-	-	34.34	-	-	26.69	-	-	-	3.14
Cheese from milk skimmed after twelve hours' standing,*	1	-	-	62.70	-	-	27.81	-	-	30.37	-	-	-	4.52
Cheese from milk skimmed after twenty-four hours' standing,*	1	-	-	57.76	-	-	23.42	-	-	31.99	-	-	-	2.35
Cheese from milk skimmed after thirty-six hours' standing,*	1	-	-	56.05	-	-	17.67	-	-	33.24	-	-	-	5.14
Cheese from milk skimmed after forty-eight hours' standing,*	1	-	-	54.59	-	-	15.77	-	-	34.94	-	-	-	3.88
Cheese from skim-milk, with addition of buttermilk,*	1	-	-	51.62	-	-	18.35	-	-	28.63	-	-	-	4.64
Genuine oleomargarine cheese,*	1	-	-	62.10	-	-	31.66	-	-	25.94	-	-	-	4.50

* From analyses made in 1875.

E. Salt for Meat Packing and Dairy Purposes.

KIND AND SOURCE.	Moisture, 100° C.	Sodium Chloride.	Calcium Sulphate.	Calcium Chloride.	Magnesium Chloride.	Sodium Sulphate.	Magnesium Sulphate.	Insoluble Matter.	Remarks.
Rock salt of Pettite Anse, La.,	.330	98.882	.782	.004	.003	-	-	-	Sent on for examination.
Rock salt of Neyba, San Domingo, W. I.,	.300	98.330	1.480	-	.090	.070	.070	-	
Solar salt, Onondaga, N. Y.,	2.500	96.004	1.315	.092	.089	-	-	-	
Solar salt, Hocking Valley, O.,	2.130	97.512	None.	.234	.089	-	-	-	
Solar salt, Saginaw Valley, Mich.,	3.314	95.813	.316	.356	.140	-	-	-	
Solar salt from Kansas,	4.950	93.060	1.220	-	.240	.350	.180	-	
Solar salt, Lincoln County, Neb.,	1.200	98.130	.250	-	.080	.390	None.	-	
Common fine and boiled salt, Onondaga, N. Y.,	3.000	95.353	1.355	.155	.136	-	-	-	
Common fine and boiled salt, Portsmouth, Mich.,	6.752	90.682	.805	.974	.781	-	-	-	
Common fine and boiled salt, Mason City, O.,	3.470	95.789	-	.614	.041	-	-	-	
Dairy and table salt, Ashton's (English),	0.760	97.652	1.430	-	.060	-	.048	.050	
Onondaga dairy salt,	0.700	97.832	1.263	-	.037	.026	.023	.120	
Fine salt, Bulletin 26, I.,	3.280	95.091	1.487	.032	.075	-	-	.035	
Fine salt, Bulletin 26, II.,	4.591	94.012	1.177	.143	.049	-	-	.028	
Fine salt, Bulletin 26, III.,	4.616	94.236	.999	.071	.026	-	-	.052	Salicylic acid: trace.
Dairy salt, sent on from Amherst, Mass.,	0.145	98.520	1.009	.189	.065	-	-	.072	
Ashton salt (sent on),	.760	97.650	1.430	-	.060	-	.050	.050	
Onondaga factory-filled (sent on),	.600	98.280	.910	-	-	.030	.060	.120	
Dairy salt, sent on from Amherst,	.505	98.202	.877	.168	.046	-	-	.202	
Rock salt from Retsof salt mines,	2.600	95.940	.420	.330	.010	-	-	.700	
Royal salt,	.880	97.877	1.108	.016	.010	-	-	.102	
Excelsior salt,	.320	98.009	1.644	.013	.014	-	-	.020	
Genesee salt,	.295	98.513	1.160	.010	.012	-	-	.010	
Genesee salt,	.235	98.563	1.137	.045	.020	-	-	-	
Bradley salt,	.200	98.575	1.185	.029	.007	-	-	-	
Higgins' Eureka salt,	.855	98.891	.906	.293	.055	-	-	-	
Worcester refined salt,	.565	97.935	1.376	.097	.027	-	-	-	

F. *Analyses of Insecticides.*

	Moisture.	Arsenious Oxide.	Copper Oxide.	Acetic Acid.	Nicotine.	Mercury.	Sulphur.	Sulphuric Acid.	Chlorine.	Calcium Oxide.	Potassium Oxide.	Ferric and Aluminic Oxides.	Insoluble Matter.
Paris green,	1.30	62.55	32.84	3.10	-	-	-	-	-	-	-	-	0.21
Paris green,	1.41	61.40	33.20	3.90	-	-	-	-	-	-	-	-	0.09
Paris green,	1.40	61.15	33.10	3.71	-	-	-	-	-	-	-	-	0.64
Paris green,	1.15	59.92	30.40	-	-	-	-	-	-	-	-	-	0.10
Paris green,	1.34	61.25	33.35	3.93	-	-	-	-	-	-	-	-	0.13
Paris green,	1.31	61.21	33.45	3.94	-	-	-	-	-	-	-	-	0.09
Paris green,	1.15	53.91	31.27	8.10	-	-	-	-	-	-	-	-	0.04
Paris green,	1.27	54.80	30.85	6.50	-	-	-	-	-	-	-	-	0.12
"Sulphatine,"	1.40	-	2.61	-	-	-	48.28	4.73	-	18.60	-	-	1.63
"Death to Rose Bugs,"	2.95	-	1.05	-	-	-	34.53	4.35	-	17.76	-	-	0.49
"Professor De Graff's Carpet Bug Destroyer,"	95.81	-	-	-	-	0.78	-	0.48	0.27	-	0.26	0.90	-
Tobacco liquor,	37.71	-	-	-	2.12	-	-	-	-	3.07	6.55	0.23	-
Tobacco liquor,	40.89	-	-	-	0.53	-	-	-	-	1.47	16.34	0.01	-
Tobacco liquor,	-	-	-	-	4.55	-	-	-	-	-	-	-	-
Tobacco liquor,	-	-	-	-	4.82	-	-	-	-	-	-	-	-
"Nicotinia,"	10.00	-	-	-	-	-	-	-	-	4.45	9.15	-	2.12
Hellebore,	-	-	-	-	-	-	-	-	-	-	-	-	2.34
Hellebore,	-	-	-	-	-	-	-	-	-	-	-	-	38.12
"Peroxide of Silicate,"	1.65	0.57	0.33	-	-	-	-	49.66	-	41.18	-	-	2.31

METEOROLOGY.

1892.

The meteorological observations have been continued as in previous years. The temperature, the force and the direction of the wind and the amount of cloudiness are recorded each day at 7 A.M., 2 P.M. and 9 P.M. During the summer months the reading of a wet-bulb thermometer takes place at the same times. Records are also taken of maximum and minimum temperatures, rainfall, and of casual meteorological phenomena.

Monthly and annual reports are sent to the headquarters of the signal service at Washington, D. C., and to the New England Meteorological Society. During the summer months partial monthly reports have been furnished also for the use of the secretary of the State Board of Agriculture.

At the beginning of the year there was no snow on the ground. After January 1 the total snowfall of the season amounted to thirty-four inches. The heaviest snow-storm during that time occurred on January 15, measuring seven inches. A storm giving six inches of snow occurred on February 11. The last storm, which was only a trace, fell on April 10.

The last frost of the season was on May 10, when the minimum thermometer registered 35° F.

The mean temperature during the first four months was 31.43° F., being a little over one degree lower than that of last year. The absolute minimum temperature was — 10°, occurring on January 15.

The mean monthly range for the four months was 18.84° F., being 14.16° lower than that of the first four months of 1891. The prevailing wind was N. N. E. for January and February, and N. W. for March and April. During the following four months, May, June, July and August, the mean temperature was 65.32° F., being 1.67° lower than that of the corresponding months of last year, while the mean range of temperature was 5° greater.

The absolute maximum temperature, viz., 94.5°, occurred on June 14. The minimum temperature was 30°, occurring on May 1. The cold wave in May was unfavorable to the germination of seeds, and was a set-back to general farming operations.

The total precipitation during the months of May, June, July and August was 17.97 inches. During the months of June and July the precipitation was slightly below the normal, and there were extreme ranges of temperature. The month of August was characterized by excessive rainfalls, the precipitation being much above the normal, and 2.03 inches more than that for August, 1891.

The month of September was very fair and pleasant, being free from severe storms, and there was no frost until the 30th, which was the first of the season. The precipitation was far below the normal. The prevailing wind was S. The temperature for October and November was about normal, while for December it was much below.

The precipitation for October and December was exceedingly small, but for November was above the normal. The total amount of snowfall during the month of November was 2.68 inches, and for December 2.75 inches. The first trace of snow for the season fell November 5. The total amount of precipitation during the year was below the normal, and was unevenly distributed. The largest amount of water falling in one month was 5.70 inches, — August; the smallest amount, 0.64 of an inch, in October; and only 0.65 of an inch fell in April, being an exceedingly small figure for that month.

Summary of Meteorological Observations, 1892.

	TEMPERATURE, DEGREES FAHRENHEIT.														
	7 A.M.	2 P.M.	9 P.M.	Mean.	Maximum.	Minimum.	Absolute Maximum.	Date.	Absolute Minimum.	Date.	Greatest Daily Range.	Date.	Least Daily Range.	Date.	Mean Daily Range.
January,	19.03	28.68	23.29	23.55	33.27	13.82	55.0	2d, 14th	—10.0	17th	37.0	26th	5.0	13th	19.45
February,	19.90	31.52	25.65	25.69	30.80	16.59	46.5	26th	—8.0	18th	52.0	18th	3.0	3d	14.21
March,	25.30	37.00	30.70	31.00	39.60	22.20	59.0	26th	5.0	22d	34.0	31st	7.0	1st	17.40
April,	40.30	54.20	43.80	45.50	57.40	33.10	76.0	5th	22.0	25th	40.0	20th	11.0	29th	24.30
May,	50.40	61.80	53.80	55.00	64.04	43.90	81.0	31st	30.0	1st	35.0	18th	6.0	21st	20.14
June,	64.40	77.40	66.60	68.77	80.03	58.40	94.5	14th	40.5	11th	38.5	11th	9.0	27th	21.60
July,	64.84	79.50	67.24	69.75	82.00	59.50	92.0	26th, 28th, 29th	42.0	17th	34.0	21st	10.0	1st	22.50
August,	63.34	76.29	65.74	67.78	78.61	58.00	90.0	10th	51.5	15th, 16th	31.5	18th	7.0	27th	20.61
September,	52.30	69.90	57.70	59.30	71.60	46.51	79.0	18th, 19th, 25th	34.0	30th	41.0	31st	8.0	14th, 24th	25.08
October,	43.63	59.45	48.47	50.00	61.57	36.56	70.0	8th, 16th	23.5	25th	35.0	13th	11.0	17th	25.01
November,	34.25	42.27	36.67	37.46	45.77	29.00	66.0	18th	14.5	24th	29.5	7th	6.5	10th	16.80
December,	21.57	32.01	23.95	26.35	34.73	17.74	55.0	12th	—1.0	27th	31.0	27th	4.5	14th	6.99
Sums,	499.26	650.02	543.61	560.15	679.42	435.32	864.0	-	244.0	-	438.5	-	88.0	-	234.09
Mean,	41.61	54.17	45.30	46.68	56.62	36.28	72.0	-	20.33	-	36.5	-	7.3	-	19.51

1892.	Precipitation, Inches.					Mean Dew Point.	Relative Humidity, Per Cent.				Wind.	Character of Days.		
	Total Amount.	Date of Greatest Fall.	Total Snowfall.	Depth of Snow the 15th.	Depth of Snow at End of Month.		7 A.M.	2 P.M.	9 P.M.	Mean.	Prevailing Direction.	Clear.	Fair.	Cloudy.
January,	5.05	2d	13.00	8.50	2.00	-	-	-	-	-	N. NE.	9	7	15
February,	1.59	3d	14.00	15.00	2.00	-	-	-	-	-	N. NE.	8	12	9
March,	2.45	23d	7.00	-	-	-	-	-	-	-	N. W.	14	10	7
April,	0.65	21st	-	-	-	-	-	-	-	-	N. W.	12	14	4
May,	5.49	21st	-	-	-	-	-	-	-	-	S. W.	4	11	16
June,	3.04	23d	-	-	-	60.0	87	56	82	75	S. W.	7	10	13
July,	3.74	30th	-	-	-	61.2	81	60	81	74	S. W.	19	7	5
August,	5.70	27th	-	-	-	62.3	90	66	90	82	N.	12	15	4
September,	1.53	15th	-	-	-	50.6	72	62	83	72	S.	22	3	5
October,	0.64	9th	-	-	-	-	-	-	-	-	N.	16	8	7
November,	4.28	16th	2.68	-	-	-	-	-	-	-	N. W.	8	9	13
December,	1.05	8th	2.75	-	-	-	-	-	-	-	N. W.	10	16	5
Sums,	35.21	-	39.43	-	-	-	-	-	-	-	-	141	122	103
Mean,	2.93	-	-	-	-	-	-	-	-	-	-	-	-	-

Casual Phenomena. — Dates.

1892.	Thunder-storms.	Solar Halos.	Lunar Halos.	Aurora.
January, . .	– –	10,	10,	5.
February, .	– –	19,	10,	13, 23, 26.
March, . .	– –	5, 16, 17, 22,	17,	6, 24, 25.
April, . .	– –	3, 5, 7, 8, 14, 15, 25,	3, 5, 7,	23, 24, 25, 26, 29.
May, . .	4,	1, 4, 5, 17, 26,	–	18.
June, . .	14, 17, 23, 30,	8, 10, 11, 13, 14, 29,	–	– –
July, . .	3, 13, 14, 16, 22, 23, 26, 28, 29,	22, 24,	4, 5,	– –
August, . .	4, 9, 11, 12, 19, 20, 26,	– –	6,	– –
September, .	26,	4, 10, 19, 21,	3,	– –
October, . .	– –	15, 20,	–	– –
November, .	– –	9, 29,	8,	4
December, .	– –	16, 20, 31,	27, 31,	– –

January, February, March, April.

	1891.	Date.	1892.	Date.
Mean temperature,	33.20°	-	31.43°	-
Absolute maximum temperature,	77.00°	April 30,	76.00°	April 5.
Absolute minimum temperature,	—5.50°	Feb. 15,	—10.00°	Jan. 17.
Mean monthly range,	33.00°	-	18.84°	-
Total precipitation (inches),	16.08	-	9.74	-
Total snowfall (inches),	58.00	-	34.00	-
Last snowfall,	-	April 3,	-	April 10.
Prevailing wind,	N. E.	-	N. E. & N. W.	-

May, June, July, August.

	1891.	Date.	1892.	Date.
Mean temperature,	63.65°	-	65.32°	-
Absolute maximum temperature,	90.00°	Aug. 11,	94.50°	June 14.
Absolute minimum temperature,	25.00°	May 1,	30.00°	May 1.
Mean monthly range,	25.25°	-	21.21°	-
Last frost,	-	June 25,	-	May 10.
Total rainfall (inches),	15.16	-	17.97	-
Prevailing wind,	N. E	-	S.W.	-

September, October, November, December.

	1891.	Date.	1892.	Date.
Mean temperature,	46.00°	-	43.28°	-
Absolute maximum temperature,	89.00°	Sept. 18,	79.00°	Sept. 18, 19, 25.
Absolute minimum temperature,	4.00°	Nov. 30,	—1.00°	Dec. 27.
Mean monthly range,	35.05°	-	18.47°	-
First frost,	-	Oct. 10,	-	Sept. 30.
Total precipitation (inches),	11.31	-	7.50	-
First snowfall,	-	Nov. 26,	-	Oct. 5.
Total snowfall (inches),	1.50	-	5.43	-
Prevailing wind,	S. E.	-	N. W.	-

Entire Year.

	1891.	Date.	1892.	Date.
Mean temperature,	47.62°	-	45.68°	-
Total precipitation (inches),	42.58	-	35.21	-
Total snowfall (inches),	59.50	-	39.43	-

ANNUAL REPORT OF C. A. GOESSMANN,

Treasurer of the Massachusetts Agricultural Experiment Station,

For the Year ending Dec. 20, 1892.

Received.		
Cash on hand from last year,	$3 31	
Cash from State Treasurer, appropriation,	10,000 00	
Cash from State Treasurer, Columbian Exhibition,	150 00	
Cash from fertilizer account,	2,310 00	
Cash from dairy bureau,	628 50	
Cash from farm,	1,014 14	
		$14,131 95

Expended.		
Cash paid salaries,	$3,927 51	
Cash paid laboratory supplies,	579 04	
Cash paid printing and office expenses,	576 45	
Cash paid farmer and farm labor,	2,254 96	
Cash paid farm supplies,	1,749 21	
Cash paid dairy bureau account,	402 06	
Cash paid fertilizer account,	2,304 50	
Cash paid construction and repairs,	774 56	
Cash paid expense of Board of Control,	152 34	
Cash paid incidental expenses,	589 66	
Cash paid library,	358 99	
Cash on hand,	462 67	
		$14,131 95

Summary of the Property of the Massachusetts State Agricultural Experiment Station (Dec. 31, 1892).

Farm.		
Live stock,	$628 88	
Tools, implements and machinery,	996 80	
Produce on hand,	832 60	
Fertilizers,	31 60	
Chemical Laboratory:		
Laboratory inventory,	3,005 27	
Office furniture, library, etc.,	1,978 50	
Agricultural and Physiological Laboratory:		
Furniture, herbariums, library (first floor),	734 35	
Instruments, apparatus, etc. (first floor),	761 20	
Furniture (second floor),	409 52	
Instruments, apparatus, etc. (second floor),	412 40	
Buildings, land, etc.,	32,202 00	
Total of inventory,		$41,993 12

This is to certify that I have examined the books and accounts of Charles A. Goessmann, Treasurer of the Massachusetts Agricultural Experiment Station, for the fiscal year ending Dec. 31, 1892, and find them correct, and all disbursements properly vouched for, with a balance in the treasury of four hundred and sixty-two sixty-seven one hundredths dollars, which is shown to be in the bank.

WM. R. SESSIONS,
Auditor.

Jan. 10, 1893.

LIST OF EXCHANGES.

Reports and Bulletins of the United States Department of Agriculture, Washington, D. C.
Reports and Bulletins of the Agricultural Experiment Stations of the United States.
Bulletin of the State Board of Agriculture, Boston, Mass.
Bulletin of the Massachusetts Horticultural Society, Boston, Mass.
The American Cultivator, Boston, Mass.
The Holstein-Friesian Register, Boston, Mass.
Massachusetts Ploughman, Boston, Mass.
New England Farmer, Boston, Mass.
New England Homestead, Springfield, Mass.
The Home and Mart, East Boston, Mass.
New York Weekly World, New York, N. Y.
German Agricultural Horticultural Journal (German), New York, N. Y.
American Agriculturist, New York, N. Y.
The Rural New Yorker, New York, N. Y.
The Florists' Exchange, New York, N. Y.
Vick's Magazine, Rochester, N. Y.
The American Analyst, New York, N. Y.
The Rural Critic, Garratsville, N. Y.
Naturalist Monthly Bulletin, Philadelphia, Pa.
The Practical Farmer, Philadelphia, Pa.
The Farm Journal, Philadelphia, Pa.
The National Stockman and Farmer, Pittsburg, Pa.
Maryland Farmer, Baltimore, Md.
Baltimore Weekly Sun, Baltimore, Md.
The Agricultural Epitomist, Indianapolis, Ind.
The New Agricultural Era, Indianapolis, Ind.
The Orange Judd Farmer, Chicago, Ill.
The Western Swineherd, Geneseo, Ill.
The Monist, Chicago, Ill.
German Agricultural and Horticultural Journal, Chicago, Ill.
Detroit Free Press (weekly), Detroit, Mich.

Farmers' Home Weekly, Dayton, O.

American Grange Bulletin, Cincinnati, O.

Journal of the Columbus Horticultural Society, Columbus, O

The Louisiana Planter, New Orleans, La.

The Wisconsin Farmer, Madison, Wis.

The Weekly Journal, Sioux City, Ia.

Western Farmer and Stockman, Sioux City, Ia.

Hospoda (Bohemian journal), Omaha, Neb.

The Industrialist, Manhattan, Kan.

The Home and Farm, Louisville, Ky.

The Industrial American, Lexington, Ky.

Southern Cultivator, Atlanta, Ga.

West American Scientist, Los Angeles, Cal.

California Cultivator and Poultry Keeper, Los Angeles, Cal.

Mirror and Farmer, Manchester, N. H.

Journal of the Elisha Mitchell Scientific Society, Chapel Hill, N. C.

The Journal of Agriculture, Montreal, Can.

Bulletins of the Central Experiment Farm, Ottawa, Can.

Bulletins of Department of Agriculture, New South Wales, Australia.

Bulletins of Department of Agriculture, Brisbane, Queensland.

Relatorio Annual da Estacao Argonomica de Campinas, Sao Paulo, Brazil.

Ragguagli, Laboratorio Chimico Agrario di Bologna, Bologna, Italy.

Reglamento, etc., Estacion Agronomica del Instituto Agricola de Alfonso XII., Madrid, Spain.

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